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VHF NAVIGATION AND COMMUNICATIONS RECEIVER 51X-2

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Agc characteristic	4 db variation maximum from 5 uv to 100,000 uv.
Agc time constant	0.5 second from 108.0 to 117.95 mc. 0.1 second from 118.0 to 151.95 mc.
Input impedance	52 ohms unbalanced; swr less than 4 to 1
Output impedances	Audio - 500 ohms balanced. ATC/VOR/LOC - 1000 ohms unbalanced, variable, at least 0.5 v output with 1000 uv input, 30% modulation into 100K load.
Output power	Capable of 100 mw with 3 uv input, 30% modulation.
Fidelity	Audio-NMT 6 db variation from 300 to 3750 cps, down at least 20 db at 120 cps and 5750 cps. ATC/VOR/LOC NMT - 6 db variation from 30 cps to 22 kc.
Harmonic distortion	7.5% maximum at 30% modulation, 100 mw output. 20% maximum at 90% modulation, 100 mw output.
Receiver disabling	The receiver will be disabled when 27.5 v d-c is applied to pin 23 of the rear connector.
Tubes and transistors	5654 -6 5670 -3 DT4-17 or 2N158A -1 DT4-18 or 2N1504 -3 (d-c supply only) 2N398 -1 (d-c supply only) Total 14

TABLE 4. 51X-2 MODULES

TYPE NUMBER	DESCRIPTION		DIMENSIONS (inches)	WEIGHT (pounds)	COLLINS PART NUMBER
	MODULE	FUNCTION			
51X-2	A1	R-F and Variable I-F Amplifier	12 x 3-1/2 x 3-1/2	4.8	542-4718-005
	A2	I-F and Audio	7-1/2 x 3 x 2-1/4	2.9	542-4748-006
516B-3 or	A3	D-C Power Supply, 27.5-v d-c input	2 x 3-1/4 x 3	0.81	522-1091-004
516A-1	A4	A-C Power Supply, 115-v 300-1000 cps input	2 x 3-1/4 x 3	0.75	522-0440-004
---	A5	500-Kc LC Filter or 500-Kc Mechanical Filter	----	---	542-4777-004 or 548-3931-003
	A6	Frame			542-4776-005

TABLE 5. ELECTRON TUBE AND TRANSISTOR COMPLEMENT

LOCATION	FUNCTION	SYMBOL	TYPE
Module A1	R-F Amplifier	V1	5654
	First Mixer	V2	5654
	Variable I-F Amplifier	V3	5654
	Second Mixer/Oscillator	V4	5670
	First Injection Oscillator	V5	5670
Module A2	First I-F Amplifier	V1	5654
	Second I-F Amplifier	V2	5654
	Third I-F Amplifier	V3	5654
	A-F Amp/Squelch	V4	5670
	Audio Output	Q1	DT4-17 or 2N158A
Module A3	Power Supply Oscillator	Q1	DT4-18 or 2N1504
	Power Supply Oscillator	Q2	DT4-18 or 2N1504
	Power Supply Blanker	Q3	DT4-18 or 2N1504
	Power Supply Blanker	Q4	2N398

TABLE 6. DIODE COMPLEMENT

LOCATION	FUNCTION	SYMBOL	TYPE
Module A2	AGC Rectifier	CR1	HD2182
	AGC Rectifier	CR2	601C
	Detector	CR3	601C
	Noise Limiter	CR4	601C
	AGC Gate	CR5	601C
	Bias Gate	CR6	601C
	Voltage Reference	CR7	ZA-35 or 1N1320
Module A3	Rectifier	CR1	1N539 or 1N1695
	Rectifier	CR2	1N539 or 1N1695
	Voltage Reference	CR3	651C0
Module A4	Rectifier	CR1	1N1695 or 1N540

O. Adapter Kit 49T-2.

(1) General.

Adapter Kit 49T-2 (see figure 2) adapts the 51X-2 Receiver to the mounting and external circuitry of a 51X-1 or 51X-1A installation. It consists of a 1/2 ATR long case outfitted with proper plugs, jacks, and wiring so that Receiver 51X-2 can be modified slightly at the front panel and slipped into the case and then the whole unit inserted into a shock-mount or rack in the place of Receiver 51X-1 or 51X-1A. The case is wired completely

VHF NAVIGATION AND COMMUNICATIONS RECEIVER 51X-2
DISASSEMBLY

1. GENERAL.

The following procedures are recommended for disassembly of Receiver 51X-2 for maintenance or adjustment purposes.

2. REMOVAL OF RECEIVER FROM SHOCKMOUNT AND EXTERIOR CASE.

A. Loosen the two hold-down nuts on the front of the shockmount allowing the nuts to be disengaged.

B. Turn the center extractor nut counterclockwise to disengage receiver from rear connector.

C. Lift receiver up and out of shockmount.

D. Loosen locking screw in the center of the rear of the dust cover case.

E. Hold case and pull receiver out of the case with the front handle.

3. REMOVAL OF MODULES.

The r-f and variable i-f module on top and the i-f and audio module on the bottom of the main chassis may be removed by loosening the captive-type hold-down screws on each module and lifting the modules straight up.

CAUTION: DO NOT TWIST OR PRY ON THE MODULE TO DISENGAGE MATING CONNECTOR, OR DAMAGE TO THE CONNECTOR MAY RESULT.

To remove the 500-kc filter module, the other three modules must be removed first, then the two coaxial connectors must be unfastened. Remove four flathead screws, and lift filter out.

4. REMOVAL OF MODULE COVERS.

To gain access to the components in the r-f and variable i-f section of the r-f and variable i-f module, remove the screws and lock washers of the two covers on the bottom of the module. To gain access to the components in the i-f and audio module, remove the wrap-around cover. To gain access to 500-kc filter components, remove wrap-around cover.

5. REPLACEMENT OF LOW-FREQUENCY CRYSTALS A1Y1 THROUGH A1Y20.

Refer to the repair section of this manual for all procedural information concerning replacement of crystals A1Y1 through A1Y20 located in the variable i-f subassembly of the r-f and variable i-f module.

6. REPLACEMENT OF HIGH-FREQUENCY CRYSTALS A1Y21 THROUGH A1Y42.

Refer to the repair section of this manual for all procedural information concerning replacement of crystals A1Y21 through A1Y42 located in the r-f subassembly of the r-f and variable i-f module.

7. DETAILED DISASSEMBLY OF R-F AND VARIABLE I-F MODULE.

A. Remove R-F Subassembly from Chassis.

(1) Remove two screws (6, figure 101), four screws (6 and 7, figure 102), and lift end plate.

(2) Remove two screws (1, figure 101) and remove clamp that holds A1P5 and A1J5 (figure 102) to module frame.

(3) Disconnect A1P5 from A1J5.

(4) Disconnect A1P3 (figure 102) from A1J3.

(5) Disconnect A1P2 (figure 102) from A1J2.

(6) Disconnect two springs on front tuning drive coupler (figure 101).

NOTE: Observe orientation of springs to aid in proper assembly. Springs should be oriented to eliminate backlash in the direction of rotation of the coupler.

(7) Remove four screws (2, figure 101) and three screws (1, figure 102).

(8) Remove retaining rings from two r-f subassembly hold-down screws (2, figure 102).

(9) Remove two hold-down screws. Remove crystal cover.

(10) Slide r-f subassembly out of module frame.

B. Disassemble R-F Subassembly.

(1) Remove retaining ring that holds switch drive collar (figure 103). Loosen setscrews on collar and remove collar.

(2) Remove three retaining rings that hold switch A1S3 crystal board (figure 103).

(3) Unsolder two wires to switch A1S3 crystal board (figure 103).

(4) Remove switch A1S3 crystal board from h-f switch shaft.

(5) Remove four screws and four flat washers (1, figure 103).

(6) Unsolder wire at switch A1S2 coil board that goes to pin 6 of A1XV5 (figure 104).

(7) Unsolder wire at switch A1S2 coil board that connects A1R19 with coil board.

(8) Remove three spacing posts that three retaining rings were mounted on (step (2)).

(9) Pull switch A1S2 coil board off h-f switch shaft.

(10) Remove three spacers on screws that held spacing posts (step (8)).

(11) Remove two spacers between switch A1S2 coil board and r-f tuner A1Z1 board.

(12) Unsolder wire at r-f board A1Z1 (figure 104) that connects with pin 4 of A1XV5.

(13) Unsolder wire at r-f tuner board A1Z1 (figure 104) that connects with A1C47.

(14) Unsolder A1TP3 wire (figure 104) at r-f tuner A1Z1 board.

(15) Remove r-f tuner board A1Z1 from h-f switch shaft.

(16) Remove retaining ring from split drive shaft.

(17) Remove drive gear (figure 104) and its associated spacing collar.

(18) Remove retaining ring from h-f switch shaft.

(19) Remove h-f switch gear (figure 104) and its associated spacing collar.

C. Remove Variable I-F Subassembly from Chassis.

(1) Remove two screws (7, figure 101), four screws (8, 9, figure 102), and lift end cover from i-f subassembly.

(2) If r-f subassembly has not been removed (paragraph 7.A.), disconnect A1P3 (figure 102) from A1J3.

(3) Disconnect A1P4 (figure 102) from A1J4.

(4) Remove two screws (3, figure 102) and remove clamp that holds A1P6 and A1J6 (figure 102) to module frame.

(5) Disconnect A1P6 from A1J6.

(6) Remove retaining rings from two hold-down screws (4, figure 102) on variable i-f subassembly and remove hold-down screws. Remove three screws from Autopositioner subassembly top cover (12, figure 102).

(7) Loosen setscrews on cam shaft collar, gear collar, and A1S6 collar.

(8) Remove one screw (10, figure 102) and six screws (3, figure 101). Cut five cable ties holding cable assembly to Autopositioner subassembly. Remove one screw holding i-f subassembly to Autopositioner gear plate (see figure 105).

(9) Slide variable i-f subassembly out of module frame. Cam shaft (figure 102) will remain attached to variable i-f subassembly. Follower arm cam, cam shaft collar, gear collar, and 84-tooth gear will slide off cam shaft.

D. Disassemble Variable I-F Subassembly.

(1) Remove three retaining rings that hold plate (figure 105) to posts and remove plate.

(2) Loosen setscrews on i-f crystal oscillator gear collar (figure 105).

(3) Remove mc dial and 50-kc dial (figure 105).

(4) Remove collar and i-f crystal oscillator gear (figure 105) which are now free of dial shaft.

(5) Remove retaining ring from 26-tooth split gear (figure 106) and remove split gear.

(6) Remove small retaining ring (figure 105) that holds dial drive shaft.

(7) Remove dial drive gear and dial drive shaft (figure 106).

(8) Remove spring from cam arm (figure 105).

(9) Loosen two setscrews on cam arm.

(10) Remove large retaining ring that holds cam arm on idler arm.

(11) Remove two retaining rings on idler arm, one on each side of bracket.

(12) Remove idler arm.

(13) Remove cam arm that is now free of idler arm.

(14) Remove retaining ring that holds odd-even cam and odd-even cam gear on bracket shaft (figure 105).

(15) Remove odd-even cam and odd-even cam gear.

(16) Remove two extension springs from slug rack (figure 102).

(17) Pull slug rack slightly toward rear of subassembly so that front guide pin is out of front guide slot (figure 102).

(18) Lift slug rack up slightly and remove cam shaft (figure 102).

(19) Remove slug rack.

E. Remove Autopositioner Subassembly from Chassis.

(1) The following removal and disassembly procedures are for an Autopositioner subassembly that is channeled to 108.00 mc. This must be done to enable loosening of setscrews in 50-kc differential cam collar, 50-kc drive shaft gear collar, and switch S6 drive shaft collar. It is also helpful to have Autopositioner subassembly channeled to 108.00 mc before disassembly so that all switches are set at their correct positions for reassembly.

NOTE: Remove the r-f subassembly (paragraph 7.A.) and variable i-f subassembly (paragraph 7.C.) before removing Autopositioner subassembly.

(2) Remove four screws (5, figure 102), eight screws (4, figure 101), and two screws and lock nuts (5, figure 101).

(3) Remove retaining ring from Autopositioner subassembly hold-down screw (11, figure 102) and remove hold-down screw.

(4) Slide Autopositioner subassembly out of module frame.

F. Disassembly of Autopositioner Subassembly.

NOTE: Refer to figure 107 for all parts references except where stated otherwise.

(1) Remove three screws (4) and three lock washers (5), from motor A1B1 (38).

(2) Cut cable ties where required, and remove motor A1B1 from front gear plate (24, 34).

(3) Remove two retaining rings (10, 11) from switch A1S8 (9).

(4) Remove switch A1S8 (9) from collar (12).

(5) Loosen two setscrews (13) on collar (12) and remove collar.

(6) Loosen two setscrews (15) on collar (14, 17) and remove collar.

(7) Remove retaining ring (18) from mc clutch shaft (43).

(8) Remove flat washer (19). More than one washer may be mounted to limit end play of clutch shaft.

(9) Remove spacing washers (20). Note number and placement of washers.

(10) Remove retaining ring (18) from 50-kc clutch shaft (53).

(11) Remove flat washer (19). More than one washer may be mounted to limit end play of clutch shaft.

(12) Remove spacing washers (20). Note number and placement of washers.

(13) Remove two screws (22) and two lock washers (23).

(14) Remove spring on follower arm (77) from pin on front gear plate (24, 34).

(15) Remove two screws (25) and two lock washers (26) from two spacing posts (133).

(16) Remove screw (25) and lock washer (26) from spacing post (136).

(17) Remove front gear plate (24, 34).

(18) Remove spacing washers (35) from 50-kc clutch shaft (53). Note number and placement of washers.

(19) Remove spacing washers (35) from mc clutch shaft (43). Note number and placement of washers.

(20) Remove 50-kc and mc Autopositioner clutch mechanism (36, 46) by loosening shaft collar shaft assembly (119, 123) and shaft collar (108), both of which are located on the rear bearing plate (139, 143). Refer to repair section of this manual for clutch disassembly, assembly, and adjustment procedures.

(21) Loosen two setscrews (76) on collar (78) and remove collar (78).

(22) Remove follower arm (77) and differential (79).

(23) Remove mc input sun gear (80) located within differential (79).

(24) Remove retaining ring (75) from differential (79) shaft.

(25) Remove follower arm (77) from differential (79).

(26) Remove front tuning drive coupler and shaft (81) from rear gear plate (139, 143).

(27) Remove two screws (104) and two phenolic washers (105) from switch A1S4 (103).

(28) Remove four spacers (106).

(29) Remove switch A1S4 (103) and switch A1S5 (107) from 42-tooth gear shaft (110). Remove collar (108).

(30) Remove three screws (73) and three lock washers (74) that hold 50-kc solenoid to rear gear plate (139, 143).

(31) Remove 50-kc solenoid (72).

(32) Remove retaining ring (111) from 42-tooth gear shaft (110).

(33) Remove 42-tooth gear (110).

(34) Remove collar (119, 123).

(35) Remove retaining ring (124) from shaft of mc drive gear (130).

(36) Remove two screws (126), two spacers (127), and two spacers (128).

(37) Remove switch A1S9 (125) and switch A1S7 (129) from shaft of mc drive gear (130).

(38) Remove three screws (73) and three lock washers (74) that hold mc solenoid (72) to rear gear plate (139, 143).

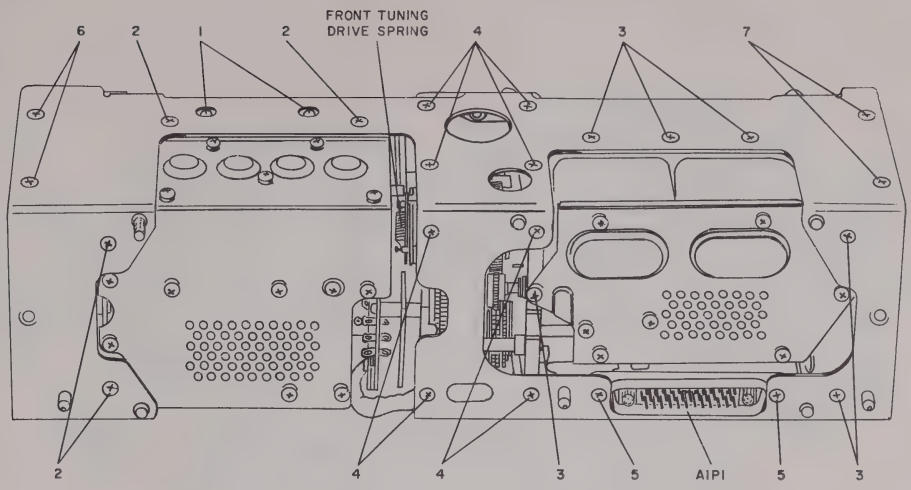
(39) Remove mc solenoid (72).

(40) Remove retaining ring (131) from shaft of mc drive gear (130).

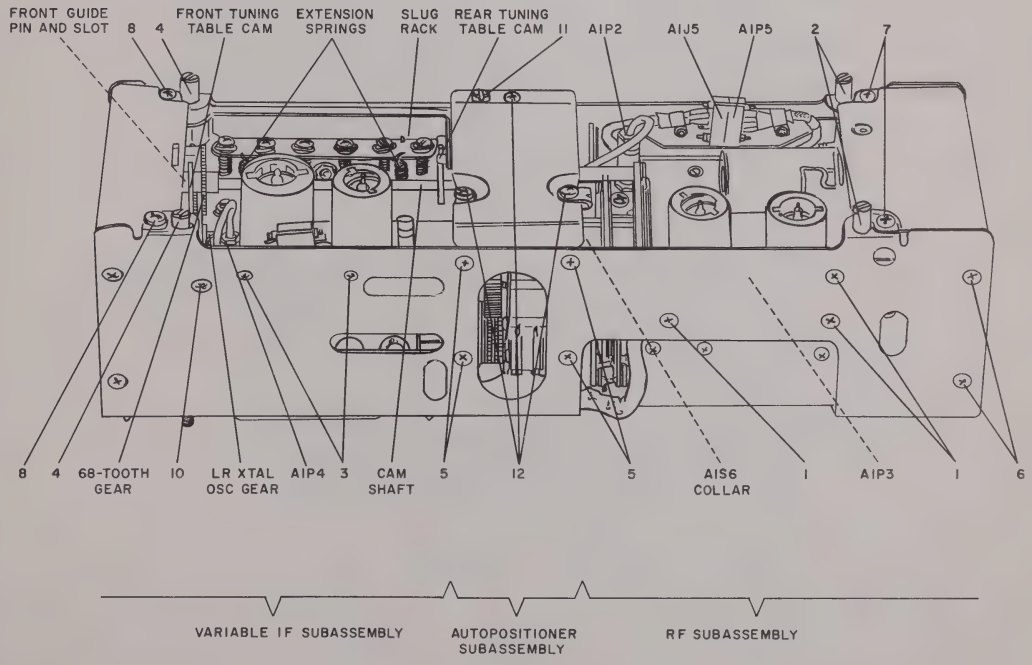
(41) Remove mc drive gear (130).

(42) Remove parts (132 through 85) and gear (132) from rear gear plate as a subassembly. Disassemble as required.

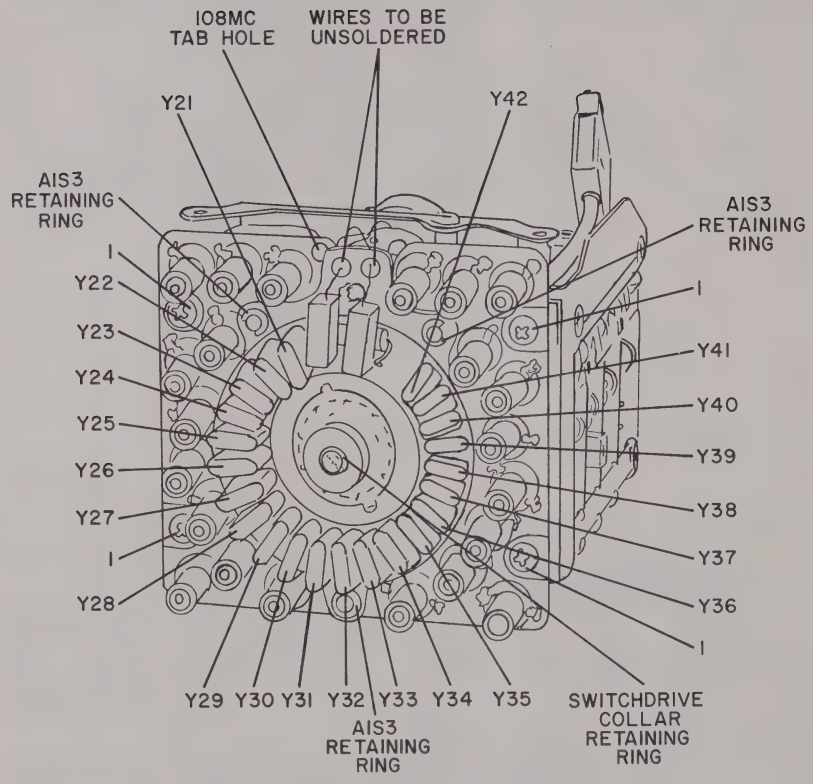
NOTE: Flat washers (83) may be between retaining rings (82, 85). Washers are used to adjust end play of blanking shaft and are not used until end play reaches a maximum limit.



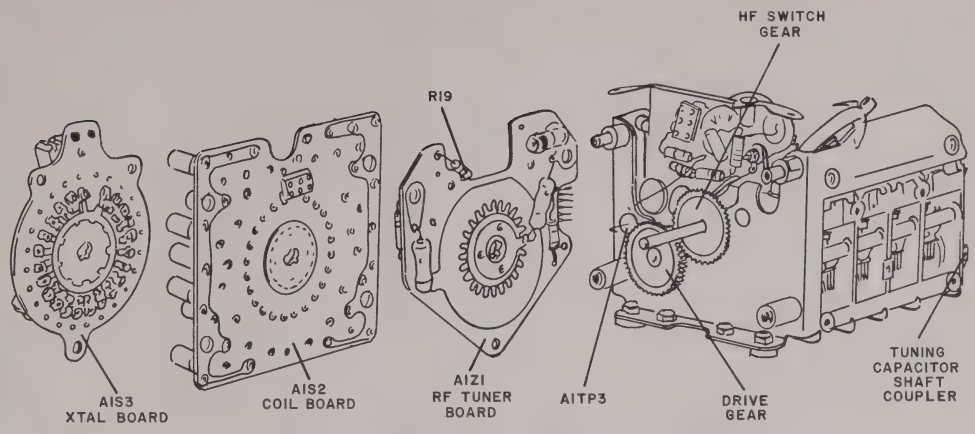
R-F and Variable I-F Module, Bottom View
Figure 101



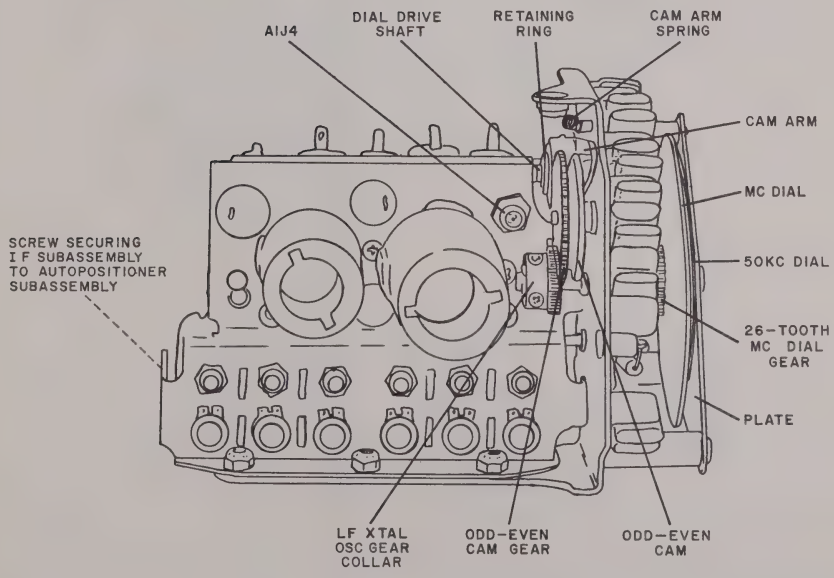
R-F and Variable I-F Module, Top View
Figure 102



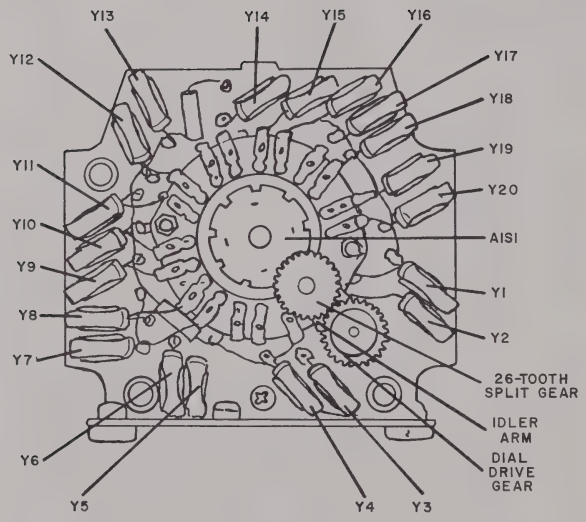
R-F Subassembly, Rear View
Figure 103



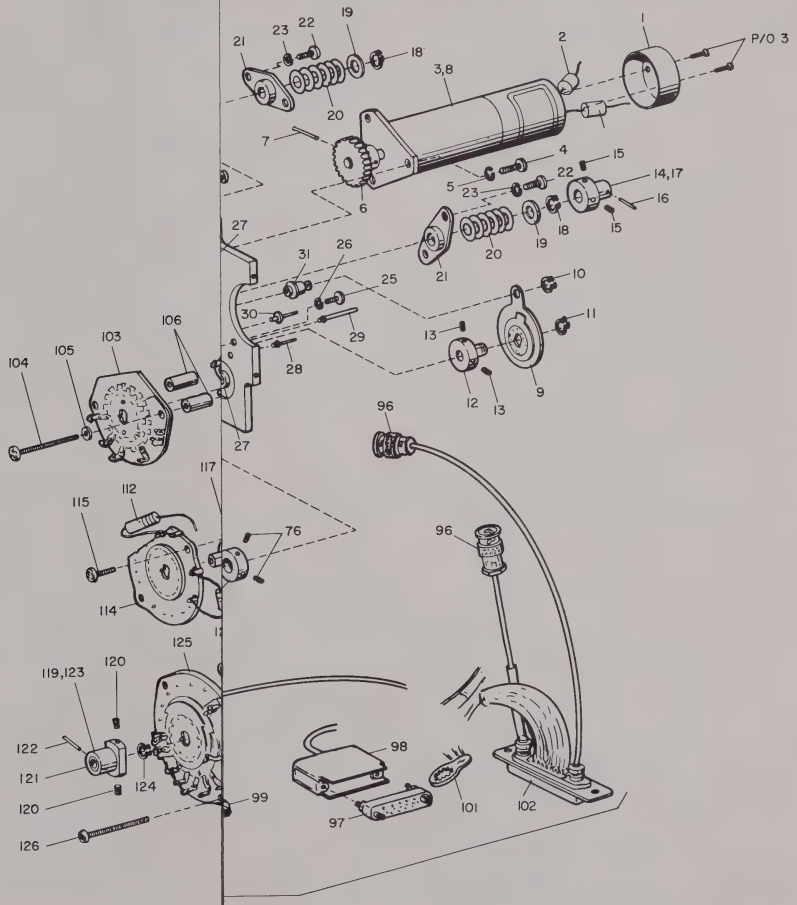
R-F Subassembly, Boards Removed
Figure 104



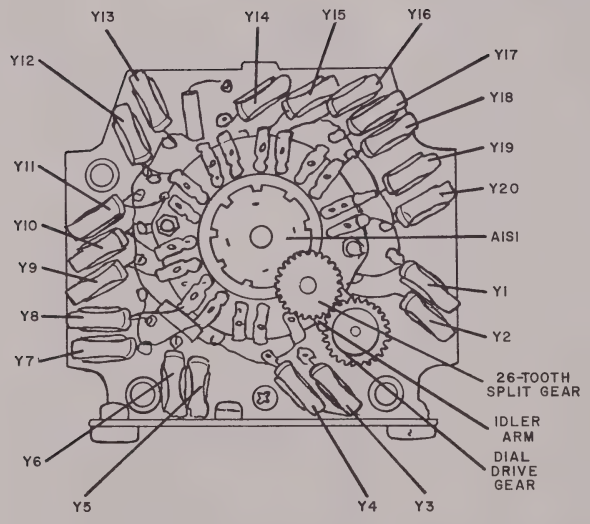
Variable I-F Subassembly, Top View
Figure 105



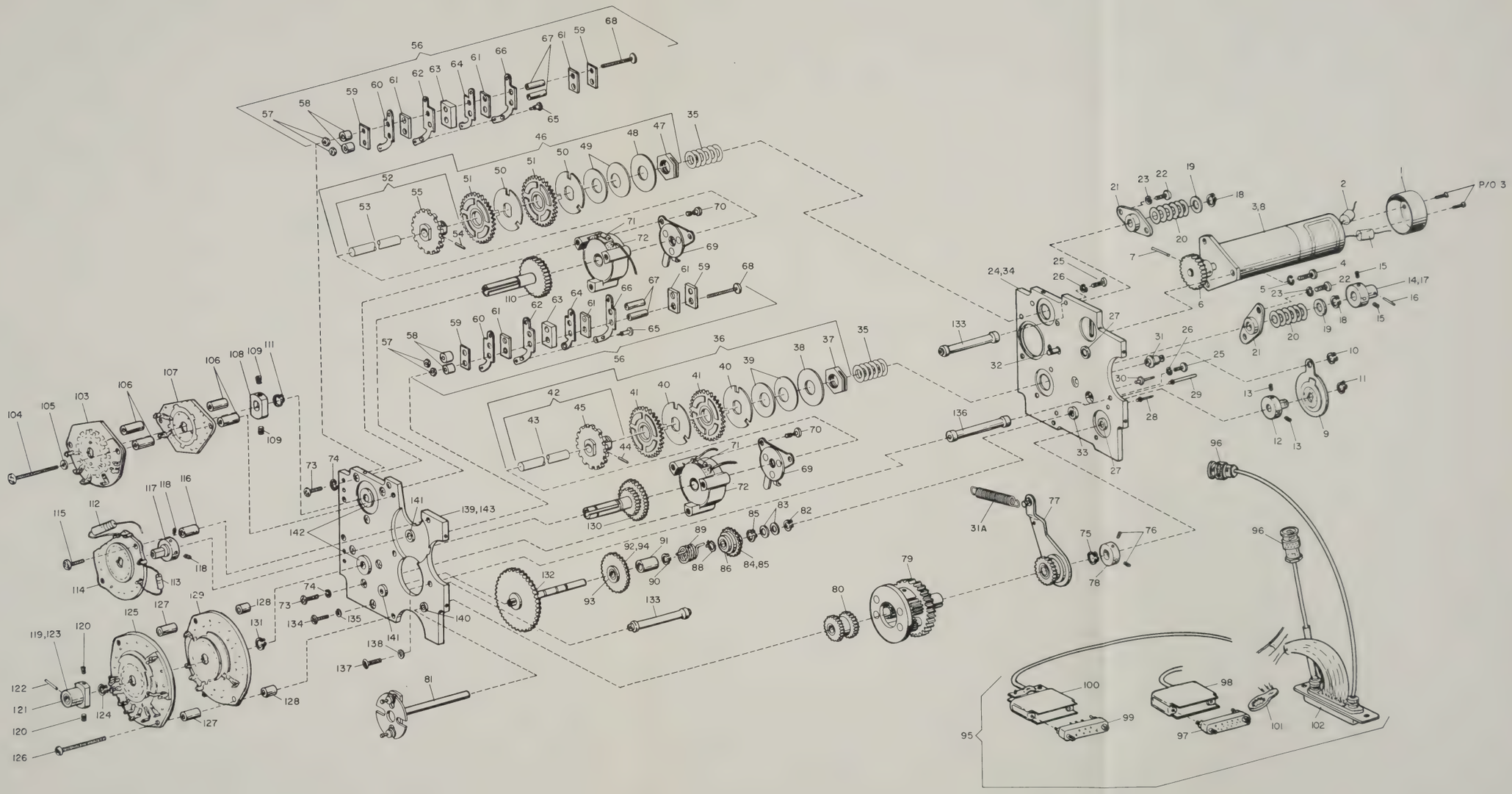
Variable I-F Subassembly, Dials Removed
Figure 106



Autopositioner Subassembly, Exploded View
Figure 107



Variable I-F Subassembly, Dials Removed
Figure 106



Autopositioner Subassembly, Exploded View
Figure 107

VHF NAVIGATION AND COMMUNICATIONS RECEIVER 51X-2
REPAIR

1. GENERAL.

This section contains instructions for the repair or replacement of worn, damaged, or defective parts.

2. REPLACEMENT OF H-F CRYSTALS A1Y1 THROUGH A1Y20.

NOTE: It is not necessary to remove the variable i-f subassembly (figure 102) for crystal replacement.

A. Remove h-f crystal cover and three retaining rings that hold plate (figure 105) to posts.

NOTE: Note readings of mc dial and 50-kc dial before removal.

B. Remove plate from three posts.

C. Loosen two setscrews on l-f crystal oscillator gear collar (figure 105).

NOTE: Do not disturb position of odd-even cam (figure 105) when removing dials in step D.

D. Remove mc dial and 50-kc dial.

E. Remove l-f crystal oscillator gear and collar which are now free of dial shaft.

NOTE: Be careful when soldering in a new crystal. Too much heat from soldering iron can damage the crystal.

F. Replace defective crystal.

G. Apply blue varnish to setscrews on l-f crystal oscillator gear collar.

H. Mount collar loosely on hub of l-f crystal oscillator gear.

I. Insert dial shaft far enough in Oilite bearing to mount l-f crystal oscillator gear and collar on shaft.

J. Mount l-f crystal oscillator gear and collar on dial shaft, hub of gear facing toward rear of module. Do not tighten collar setscrews.

K. Position mc dial and 50-kc dial so that they will have same reading as on removal.

L. Push dial shaft in, meshing 26-tooth mc dial gear (figure 105) with 26-tooth split gear (figure 106). Do not disturb setting of switch A1S1 (figure 106).

M. Push l-f crystal oscillator gear and collar in on dial shaft, meshing l-f crystal oscillator gear with odd-even cam gear (figure 105) and with 68-tooth gear on cam shaft (figure 102). Make sure that odd-even cam is in same position as noted on removal.

N. Tighten two setscrews on 1-f crystal oscillator gear collar. Do not tighten setscrews on cross slots in split hub of gear. Check that end play of dial shaft does not unmesh gears in step M.

O. Mount plate on three posts.

NOTE: Use new retaining rings in step D if retaining rings were bent on removal.

P. Mount three retaining rings on three posts (step O).

Q. If settings of mc dial, 50-kc dial, switch A1S1, or odd-even cam were disturbed or are incorrect, perform the procedures below.

(1) Mount r-f and variable i-f module on 51X-2 chassis, and channel receiver to 108.00 mc. Remove r-f and variable i-f module from chassis. Repeat steps A, B, and C.

(2) Pull dials out far enough to unmesh 26-tooth mc dial gear from 26-tooth split gear.

(3) Unmesh 1-f crystal oscillator gear from odd-even cam gear and from 68-tooth gear on cam shaft.

(4) Position switch A1S1 at crystal A1Y1 (figure 106).

(5) Rotate 50-kc dial toward repairman, so that .00-mc reading is at approximate left horizontal position.

(6) Rotate mc dial so that 108-mc reading is lined up with .00-mc reading on 50-kc dial.

(7) Push dials in while remeshing gears in step (2). Be careful not to move tab of switch A1S1 from A1Y1 and keep 108-mc reading lined up with .00-mc reading.

(8) Mount plate on posts and mount three retaining rings.

(9) Check that 108-mc reading and .00-mc reading are centered in plate window. Slightly adjust dials, if necessary.

(10) Position odd-even cam so that pin on cam arm is on low half of odd-even cam and any further clockwise rotation (front of module facing repairman) of odd-even cam would begin to raise pin to high half of odd-even cam.

(11) Remesh gears in step (3) holding odd-even cam in position in step 10.

(12) Tighten setscrews on 1-f crystal oscillator gear collar. Do not tighten setscrews on cross slots in split hub.

(13) Check that odd-even cam is still positioned correctly (step 10)).

(14) Push dial shaft back and forth and check that end play of dial shaft does not unmesh gears in step (11). Adjust positioning of 1-f crystal oscillator gear if necessary.

(15) Check that .00-mc reading is still centered in plate window.

3. REPLACEMENT OF VHF CRYSTALS A1Y21 THROUGH A1Y42. (Figure 103).

NOTE: It is not necessary to remove the r-f subassembly (figure 102) for crystal replacement.

A. Remove vhf crystal cover and retaining ring that holds switch drive collar.

B. Loosen two setscrews on switch drive collar and remove collar.

C. Remove three retaining rings that hold switch A1S3 crystal board.

D. Unsolder two wires at switch A1S3 crystal board.

NOTE: Do not rotate switch A1S3 when removing crystal board.

E. Remove switch A1S3 crystal board.

CAUTION: BE CAREFUL WHEN SOLDERING IN A NEW CRYSTAL. TOO MUCH HEAT FROM THE SOLDERING IRON CAN DAMAGE THE CRYSTAL.

F. Replace defective crystal.

G. Mount switch A1S3 crystal board.

NOTE: Use new retaining rings in step H if retaining rings were bent on removal.

H. Mount three retaining rings that hold switch A1S3 crystal board.

I. Solder two wires at switch A1S3 crystal board.

J. Apply blue varnish to two setscrews on switch drive collar.

NOTE: Do not disturb setting of switch A1S3 when mounting switch drive collar.

K. Mount switch drive collar.

L. Tighten setscrews on switch drive collar.

M. If setting of switch A1S3 was disturbed, perform the following synchronization procedures.

(1) Mount r-f and variable i-f module on 51X-2 chassis, and channel receiver to 108.00 mc.

(2) Remove r-f and variable i-f module from chassis.

(3) Loosen two setscrews on switch drive collar.

(4) Rotate switch drive collar clockwise, rear of module facing repairman, until tab of switch A1S3 is positioned in 108-mc tab hole (figure 103). This positions switch A1S3 at crystal A1Y21 which corresponds to a 108-mc setting. Clockwise rotation of switch reduces backlash.

(5) Tighten setscrews on switch drive collar.

4. REPLACEMENT OF PARTS IN AUTOPOSITIONER CLUTCH MECHANISMS. (See figure 107.)

A. Remove nut (47).

B. Slip clutch discs (48 and 50), clutch springs (49), and clutch gears (51) from Autopositioner clutch mechanism shaft.

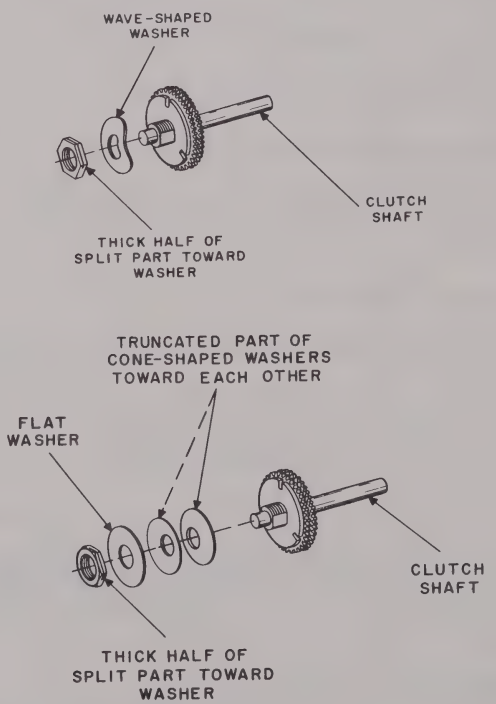
C. Reassemble Autopositioner Clutch mechanisms using new parts as required. Refer to figure 401 as an aid in correct assembly procedures.

CAUTION: AUTOPOSITIONER CLUTCH WORKING SURFACES AND CLUTCH GEAR TEETH MUST NOT BE LUBRICATED, AND MUST BE KEPT FREE OF ALL FOREIGN CONTAMINATES AT ALL TIMES.

D. Adjust clutch torque according to following procedure. Use an accurate torque meter accurate to the nearest 1.5 inch-ounce with a maximum reading of 80 to 96 inch-ounces.

(1) Attach a suitable torque meter to Autopositioner clutch mechanism shaft and secure clutch gears to a suitable locking device, such as a machinist's vice. Protect clutch gear teeth with wooden blocks.

(2) Tighten nuts (37) on Autopositioner clutch mechanism to flat position of conical clutch bearings. (This is done to ensure that clutch springs do not bind on shaft threads.) Back off nut (37) to approximate torque output indication given in table 401.



Assembly Diagram, Autopositioner
Clutch Mechanisms
Figure 401

NOTE: Autopositioner clutch mechanisms in older units may contain one wave-type washer. In this case, nut (37) should not be tightened down completely. Adjust nut to approximate torque output indication given in table 401. See figure 401.

(3) Run in Autopositioner clutch mechanism 10 seconds on and 10 seconds off at the approximate torque output values given in table 401 for a minimum of 100 revolutions.

(4) Allow Autopositioner clutch mechanism to cool for 30 minutes before making final adjustment according to table 401.

TABLE 401. TORQUE OUTPUT ADJUSTMENT OF AUTOPOSITIONER CLUTCH MECHANISMS

ITEM NUMBER (See figure 107)	SUBASSEMBLY	OUTPUT TORQUE (inch-ounce)
46	Kc clutch	44^{+0}_{-8}
36	Mc clutch	56^{+0}_{-8}

NOTE: New pretorqued kc and mc Autopositioner clutch mechanisms are available under Collins part numbers 547-3224-003 and 547-3223-003 respectively. If these Autopositioner clutch mechanisms are being substituted, run-in is not required. Install Autopositioner clutch mechanism according to assembly section of this manual.

NOTE: It is very important that the torque readings do not fall below the minimum values listed in table 401. This may cause clutches to slip continuously and prevent gear trains from rotating. A torque setting above the maximum value will permit operation of Autopositioner gear trains, but will cause excessive clutch and motor wear and will increase channel selection time.

VHF NAVIGATION AND COMMUNICATIONS RECEIVER 51X-2
ASSEMBLY

1. GENERAL.

The following procedures are recommended for assembly of VHF Navigation and Communications Receiver 51X-2 for maintenance or adjustment purposes.

2. DETAILED ASSEMBLY AND ADJUSTMENT OF R-F AND VARIABLE I-F MODULE.

A. Assemble Autopositioner Subassembly.

NOTE: Refer to figure 107 for all parts references except where stated otherwise.

(1) Perform the following general instructions during reassembly:

(a) Check switches for bent or broken contacts before mounting.

(b) Replace any cable ties that were removed on disassembly.

(c) Inspect all retaining rings for original shape before replacing and for proper closing after replacement. Use new retaining rings if necessary.

(d) Liquid stake all screw threads with blue varnish where stated in the assembly procedure.

(e) Lubricate Oilite and sleeve bearings with MIL-L-6085A where stated in assembly procedures.

(f) Lubricate rotors of switches A1S4 (103), A1S5 (107), A1S6 (114), A1S7 (129), A1S8 (9), and A1S9 (125) with the following mixture. Apply with a small camel-hair brush and remove excess with a clean cloth.

1. 2.5 parts by volume of n-butyl alcohol.

2. 2.5 parts by volume of xylene.

3. 5.0 parts by volume of MIL-L-6085A.

CAUTION: DO NOT LUBRICATE ANY OF THE MC CLUTCH PARTS (36) OR THE 50-KC CLUTCH PARTS (46). THESE PARTS MUST BE KEPT FREE OF ALL CONTAMINANTS (GREASE, OIL, DIRT, AND SO ON) AT ALL TIMES.

NOTE: The following reassembly procedures position the Autopositioner subassembly to 108.00 mc. Do not tighten collar setscrews unless so stated. Use five to six inch-pounds of torque when tightening collar setscrews.

(2) Mount 57-tooth loading gear (92, 94) on blanking shaft (132), hub of loading gear away from 76-tooth spur gear on blanking shaft.

(3) Mount retaining ring (88) on blanking shaft next to hub of loading gear.

(4) Mount sleeve bearing (91) on blanking shaft.

(5) Mount retaining ring (90) on blanking shaft next to sleeve bearing.

(6) Mount torsion spring (89) on sleeve bearing. Place end of torsion spring in hole in 57-tooth loading gear (92, 94).

(7) Mount 38-tooth loading gear (84, 85) on blanking shaft, large diameter hub of loading gear towards torsion spring.

(8) Place other end of torsion spring in hole in 38-tooth loading gear.

NOTE: If two flat washers (83) were between retaining rings (82, 85) on blanking shaft (132) in step (42) when subassembly was disassembled, mount washers between retaining rings. If washer or washers were between outermost retaining ring and front gear plate (24, 34) on disassembly, mount washer or washers between outermost retaining ring and front gear plate. Washers are used to adjust end play of blanking shaft which may increase due to wear of parts.

(9) Mount two retaining rings (82, 85) on blanking shaft.

(10) Lubricate Oilite bearings on rear gear plate with one drop of MIL-L-6085A. Remove any excess.

(11) Mount assembled parts (82 through 132) in associated Oilite bearing in rear gear plate (139, 143).

(12) Mount drive gear (130) in associated Oilite bearing in rear gear plate, meshing 38-tooth mc drive gear with 76-tooth spur gear (132) and meshing 57-tooth gear with 57-tooth loading gear (92, 94).

(13) Mount retaining ring (131) on shaft of mc drive gear (130).

(14) Mount 42-tooth gear (110) in associated Oilite bearing in rear gear plate.

(15) Mount retaining ring (111) on 42-tooth gear (110) shaft.

(16) Mount collar (108) on 42-tooth gear shaft (110).

(17) Mount 50-kc solenoid (72) to rear gear plate with three screws (73) and three lock washers (74).

(18) Mount mc solenoid (72) to rear gear plate with three screws (73) and three lock washers (74).

(19) Rotate switch segments of switch A1S7 (129) so that indentation in switch segments (figure 501) is in same position on all segments.

(20) Rotate switch segments of switch A1S9 (125) so that indentation in switch segments (figure 501) is in same position on all segments. Line up indentations of switch segments of A1S9 so that they are in same position as indentations of switch segments of A1S7 in step (19).

(4) Mount sleeve bearing (91) on blanking shaft.

(5) Mount retaining ring (90) on blanking shaft next to sleeve bearing.

(6) Mount torsion spring (89) on sleeve bearing. Place end of torsion spring in hole in 57-tooth loading gear (92, 94).

(7) Mount 38-tooth loading gear (84, 85) on blanking shaft, large diameter hub of loading gear towards torsion spring.

(8) Place other end of torsion spring in hole in 38-tooth loading gear.

NOTE: If two flat washers (83) were between retaining rings (82, 85) on blanking shaft (132) in step (42) when subassembly was disassembled, mount washers between retaining rings. If washer or washers were between outermost retaining ring and front gear plate (24, 34) on disassembly, mount washer or washers between outermost retaining ring and front gear plate. Washers are used to adjust end play of blanking shaft which may increase due to wear of parts.

(9) Mount two retaining rings (82, 85) on blanking shaft.

(10) Lubricate Oilite bearings on rear gear plate with one drop of MIL-L-6085A. Remove any excess.

(11) Mount assembled parts (82 through 132) in associated Oilite bearing in rear gear plate (139, 143).

(12) Mount drive gear (130) in associated Oilite bearing in rear gear plate, meshing 38-tooth mc drive gear with 76-tooth spur gear (132) and meshing 57-tooth gear with 57-tooth loading gear (92, 94).

(13) Mount retaining ring (131) on shaft of mc drive gear (130).

(14) Mount 42-tooth gear (110) in associated Oilite bearing in rear gear plate.

(15) Mount retaining ring (111) on 42-tooth gear (110) shaft.

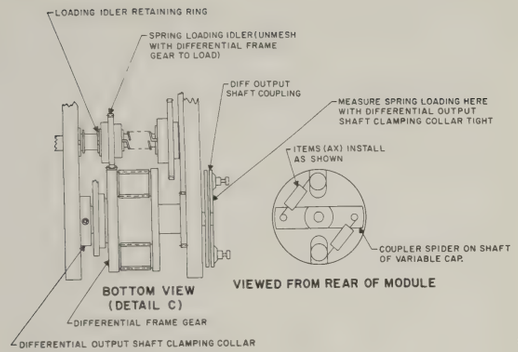
(16) Mount collar (108) on 42-tooth gear shaft (110).

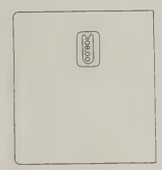
(17) Mount 50-kc solenoid (72) to rear gear plate with three screws (73) and three lock washers (74).

(18) Mount mc solenoid (72) to rear gear plate with three screws (73) and three lock washers (74).

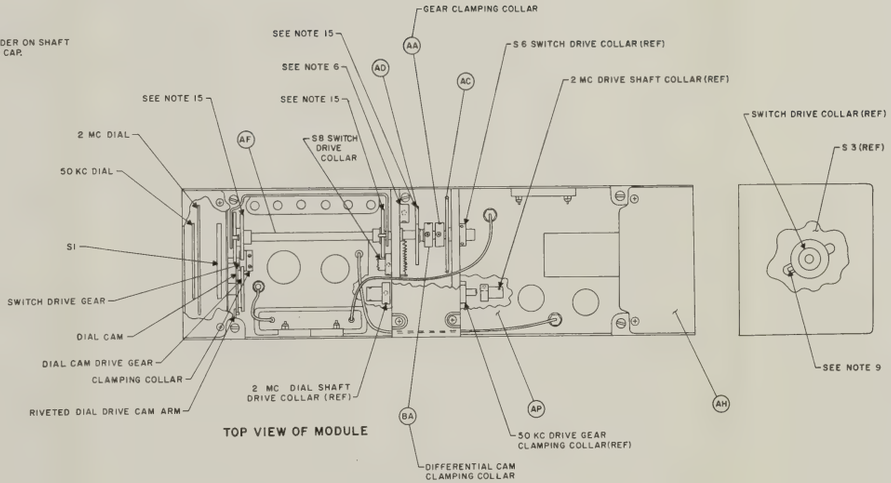
(19) Rotate switch segments of switch A1S7 (129) so that indentation in switch segments (figure 501) is in same position on all segments.

(20) Rotate switch segments of switch A1S9 (125) so that indentation in switch segments (figure 501) is in same position on all segments. Line up indentations of switch segments of A1S9 so that they are in same position as indentations of switch segments of A1S7 in step (19).

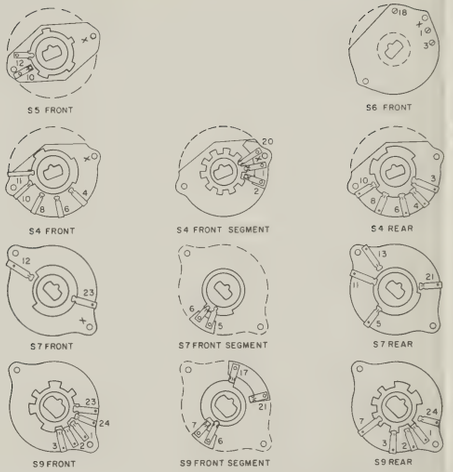




FRONT VIEW OF MODULE



TOP VIEW OF MODULE



ALL SWITCHES VIEWED FROM REAR OF MODULE
(DETAIL A)

S8 VIEWED FROM FRONT OF MODULE
(DETAIL B)

NOTES

1. PRIOR TO SYNCHRONIZATION OF THE MODULE PER FOLLOWING NOTES (2 THRU 17) INSURE THE FOLLOWING:
   (A) SET SCREWS OF ALL CLAMPING COLLARS ARE LOOSE.
   (B) THAT BOTH AUTOPOSITIONER PAWLS ARE FULLY ENGAGED IN RESPECTIVE (STOP) WHEEL NOTCHES
2. VISUALLY ALIGN ROTORS OF S4 FRONT AND S4 FRONT SEGMENT AS SHOWN IN DETAIL "A". THIS CORRESPONDS TO A 50KC AUTOPOSITIONER POSITION OF "00"KC. INSURE THAT 50KC DRIVE GEAR AND ITS RETAINING RING DOES NOT LIMIT AUTOPOSITIONER END PLAY. TIGHTEN LEFT SET SCREW (VIEWED FROM FRONT OF MODULE) OF 50KC DRIVE GEAR CLAMPING COLLAR. BE SURE THAT THE END PLAY OF THE 50KC AUTOPOSITIONER SHAFT IS NOT LIMITED BY THE COLLAR. POSITION THE DRIVE GEAR IN THE CENTER OF ITS END PLAY BEFORE TIGHTENING THE COLLAR.
3. POSITION TUNING TABLE FOLLOWERS ON LOWEST "OPERATING" POINT ON CAMS. POSITION GEAR (ITEM AC) TO ALLOW .010 NOMINAL END PLAY OF CAM SHAFT AND FULLY TIGHTEN SET SCREWS IN POSITION SHOWN ON GEAR CLAMPING COLLAR (ITEM AA).
4. VISUALLY ALIGN ROTOR OF S6 AS SHOWN IN DETAIL "A". LATERALLY POSITION S6 SWITCH DRIVE COLLAR SO AS NOT TO LIMIT END PLAY OF THE CAM SHAFT, ITEM (AF) AND TIGHTEN THE COLLAR SET SCREWS.
5. NOMINALLY CENTER THE "00" POSITION ON THE 50KC DIAL WITHIN THE BEARING PLATE APERTURE. POSITION THE RIVETED DIAL DRIVE CAM ARM ON THE LOW POINT OF THE DIAL DRIVE CAM (1ST LOW POINT REACHED WHEN ROTATING THE CAM COUNTERCLOCKWISE FACING THE FRONT OF THE UNIT) MESH THE SWITCH DRIVE GEAR WITH THE DIAL CAM DRIVE GEAR AND THE GEAR ON THE 50KC CAM SHAFT. ADJUST FOR NOMINAL LATERAL FULL MESH. TIGHTEN THE SET SCREWS IN THE CLAMPING COLLAR AS SHOWN.
6. LOOSEN COLLAR CLAMP ON REAR OF DIFFERENTIAL AND ADJUST TUNING CAPACITOR SO THE ROTOR PLATES FULLY ENGAGE THE STATOR PLATES. POSITION ONE SET SCREW OF COLLAR ON BOTTOM AND THE OTHER TOWARDS THE INSIDE. TIGHTEN BOTTOM SCREW ONLY.
7. LOOSEN DIFFERENTIAL CAM CLAMPING COLLAR, ITEM (BA) AND POSITION DIFFERENTIAL CAM, ITEM (AD) SO THAT THE CAM FOLLOWER ARM JUST CLEARS THE HIGH POINT OF THE CAM AND RESTS ON THE LOWEST OPERATING POINT OF THE CAM. TIGHTEN SET SCREWS OF DIFFERENTIAL CAM CLAMPING COLLAR AS SHOWN.
8. VISUALLY ALIGN ROTORS OF S7 & S9 AS SHOWN IN DETAIL "A". THIS CORRESPONDS TO A 2 MC AUTOPOSITIONER SETTING OF "108" MC. TIGHTEN THE BOTTOM SET SCREW ON 2MC DRIVE SHAFT COLLAR AS SHOWN.
9. AFTER ALIGNMENT OF S7 & S9 AND BEFORE ATTACHING COVER, ITEM (AH), ALIGN SWITCH ROTOR TAB OF S3 AS SHOWN. TIGHTEN SWITCH DRIVE COLLAR AS SHOWN.
10. NOMINALLY CENTER THE 2MC DIAL TO "108" WITHIN THE BEARING PLATE APERTURE. SEAT 2MC DIAL SHAFT DRIVE COLLAR AGAINST RETAINING RING AND TIGHTEN SET SCREWS AS SHOWN.
11. VISUALLY ALIGN ROTOR OF S8 AS SHOWN IN DETAIL B. TIGHTEN THE SWITCH DRIVE COLLAR SET SCREWS AS SHOWN.
12. IN ALL CASES WHERE COLLARS TIGHTEN ON SPLIT HUBS, MAKE CERTAIN SET SCREWS DO NOT TIGHTEN DOWN ON CROSS SLOTS IN HUB.
13. (SEE DETAIL C) SPRING LOAD THE DIFF. OUTPUT SHAFT PRIOR TO INSTALLATION OF THE RF AMPL SUBASSY. (ITEM AP) TO 8 ± 1 IN. OZ. (MEASURED WITH THE 50KC CAM ARM FOLLOWER ON THE LOW POINT OF THE CAM). LOAD BY ROTATING THE SPRING LOADING IDLER GEAR CCW (VIEWED FROM FRONT).
14. INSURE THAT ALL POROUS BRONZE (OILITE) BEARINGS ARE LUBRICATED WITH AN-O-64 OIL.
15. PRIOR TO ASSEMBLY: COAT WORKING SURFACE ONLY OF CAMS WITH LUBRICANT 005 0334 00 AND WIPE OFF ALL VISIBLE REMAINS. CAUTION: KEEP BORE OF CAM, (ITEM AD), FREE OF LUBRICANT.
16. UPON ASSEMBLY, LUBRICATE WORKING SURFACE OF CAMS AND TUNING TABLE GUIDE SLOTS IN THE TABLE, GEAR PLATE AND VAR. I.F. SUPPORT BRACKET WITH A THIN FILM OF LUBRICANT 005 0353 00.
17. CAUTION: KEEP A/P CLUTCH SURFACES AND CLUTCH GEAR TEETH FREE OF FOREIGN CONTAMINANTS, (GREASE OIL, ETC.) AT ALL TIMES.
18. ADJUST THE CONTACTS ON SOLENOIDS K1 & K2 AS FOLLOWS: (CAUTION: REFER TO NOTE 20.)
    1. SO THAT .020 MIN. GAP EXISTS BETWEEN CONTACTS WHEN THE SOLENOID IS DE-ENERGIZED AND THE PAWL TIP IS FULLY SEATED IN A NOTCH IN THE STOP WHEEL.
    2. SO THAT THE MOTOR STARTING CONTACTS (i.e. THOSE TOWARD THE REAR OF THE MODULE) ARE CLOSED WHEN THE PAWL TIP IS RESTING ON THE FACE OF THE STOP WHEEL (SURFACE BETWEEN NOTCHES), .B. ARE OPEN WITH 25% MAXIMUM ENGAGEMENT OF A NOTCH.
    3. SO THAT .015 MIN. OVER-TRAVEL (FOLLOW UP) IS EVIDENT WHEN THE SOLENOID IS IN THE FULLY ENERGIZED POSITION.
    4. SO THAT THE RECEIVER MUTING CONTACTS (THOSE TOWARD THE FRONT OF THE MODULE) CLOSE AT THE SAME TIME PRIOR TO THE MOTOR STARTING CONTACTS. BE SURE THAT THE END PLAY OF THE MEGACYCLE AUTOPOSITIONER SHAFT IS NOT LIMITED BY THE COLLAR. POSITION THE DRIVE GEAR IN THE CENTER OF ITS END PLAY BEFORE TIGHTENING THE COLLAR.
19. TIGHTEN SET SCREWS WHERE SPECIFIED USING 5 TO 6 INCH POUNDS OF APPLIED TORQUE.
20. ADJUST ONLY THE STATIONARY CONTACTS OF K1 AND K2. USE SMOOTH JAWED PLIERS AND ADJUST AT THE CENTER OF THE ARM.

R-F and Variable I-F Module Synchronization Diagram
Figure 501

(21) Rotate shaft of mc drive gear (130) so that flat sides of shaft line up with double-D hole in segments of switches A1S7 and A1S9.

(22) Mount switch A1S7 and switch A1S9 loosely on shaft (130). Keep indentations of switch segments lined up with each other when placing on shaft.

(23) Rotate switch segments of switch A1S4 (103) and switch A1S5 (107) so that indentation in switch segments (figure 501) is in same position on all segments. Line up indentations of A1S4 with indentation in switch segment of A1S5.

(24) Mount switch A1S4 and switch A1S5 (103, 107) loosely on shaft of 42-tooth gear (110). Keep switch A1S6 (114) between switch A1S5 and rear gear plate and keep switch A1S9 (125) between A1S4 and rear gear plate.

(25) Mount switch A1S7 (129) and switch A1S9 (125) to rear gear plate with two spacers (128), two spacers (127), and two screws (126). Liquid stake screws (126).

(26) Mount retaining ring (124) to shaft (130).

(27) Mount switch A1S4 (103) and switch A1S5 (107) to rear gear plate with four spacers (106), two phenolic washers (105), and two screws (104). Liquid stake screws (104).

(28) Mount mc clutch (36) on mc solenoid. Mc clutch has a longer shaft than 50-kc clutch.

(29) Mount 50-kc clutch (46) on 50-kc solenoid (72).

(30) Mount front tuning drive coupler (81) in its associated Oilite bearing in rear gear plate.

(31) Lubricate Oilite bearing in mc input gear and mc sun gear (80) with one drop of MIL-L-6085A. Remove any excess.

(32) Mount mc input sun gear (80) on shaft of front tuning drive coupler (81). Place thickest gear (mc input gear) towards rear gear plate.

(33) Mesh mc input gear (80) with 76-tooth spur gear (132).

(34) Lubricate Oilite bearing in follower arm gear (77) with one drop of MIL-L-6085A. Remove any excess.

(35) Mount follower arm (77) on shaft of differential (79) and mesh follower arm gear with planet gears of differential.

(36) Mount retaining ring (75) on shaft of differential.

(37) Mount differential and follower arm on shaft of front tuning drive coupler (81) with follower arm positioned between spacing post (136) and 38-tooth loading gear (84, 85).

(38) Mesh planet gears of differential with mc sun gear (80).

(39) Mesh differential loading gear (79) with 38-tooth loading gear (84, 85).

(40) Mount collar (78) on differential shaft.

(41) Lubricate Oilite bearings on front gear plate. Apply one drop of MIL-L-6085A and remove any excess.

(42) Mount front gear plate (24, 34), inserting blanking shaft (132) and shaft of front tuning drive coupler (81) in associated Oilite bearings on front gear plate.

(43) Mount front gear plate to spacing posts (133) with two screws (25) and two lock washers (26).

(44) Mount front gear plate to spacing post (136) with screw (25) and lock washer (26).

(45) Check end play of blanking assembly (82, 132) by inserting a shim between flat washers (83) and Oilite bearing on front gear plate if flat washers are between outermost retaining ring (82) and front gear plate. Insert a shim between outermost retaining ring and Oilite bearing on front gear plate if flat washers are between two retaining rings (82, 85). End play of blanking shaft should be less than 0.018 inch. If end play is greater than 0.018 inch, remove front gear plate from spacing posts and use flat washers between outermost retaining ring and front gear plate to adjust end play. Temporarily mount front gear plate to spacing posts in steps (43) and (44) before rechecking end play. Remove front gear plate.

(46) Mount spacing washers (35) on 50-kc clutch shaft (53), placing same amount of washers on inside of 50-kc bearing collar (21) as noted on disassembly (paragraph 7.F.(9)). If it is not known what number of washers were removed, mount six washers.

(47) Lubricate 50-kc bearing collar with one drop of MIL-L-6085A. Remove any excess.

(48) Mount 50-kc bearing collar on front gear plate with two screws (22) and two lock washers (23). Mount hub of bearing collar toward front gear plate.

(49) Mount spacing washers (20) on 50-kc clutch shaft, placing same amount of washers on outside of 50-kc bearing collar as noted on disassembly (paragraph 7.F.(9)). If it is not known what number of washers was removed, mount six washers.

(50) Mount flat washer (19), or washers, on 50-kc clutch shaft.

(51) Temporarily mount front gear plate to spacing posts.

(52) Mount retaining ring (18) on 50-kc clutch shaft.

(53) Check end play of 50-kc clutch shaft for a maximum of 0.003 inch. If end play is greater than 0.003 inch, add spacing washers (20) between flat washer (19) and 50-kc bearing collar until end play is 0.003 inch or less. Flat washers (19) may be used instead of spacing washers. Do not move spacing washers from inside to outside of 50-kc bearing collar to adjust end play. Total number of spacing washers on both sides of 50-kc bearing collar adjusts end play.

(54) Push 50-kc pawl (69) toward 50-kc solenoid (72) as far as possible so that 50-kc pawl is in energized position.

(55) Use a shim to check that clearance between 50-kc pawl tip and surface of 50-kc notch wheel is 0.004 to 0.014 inch. If clearance is less than 0.004 inch, move one or more spacing washers (35) from inside of 50-kc bearing collar to outside of 50-kc bearing collar; this adjusts 50-kc clutch toward front gear plate and allows more pawl clearance. If pawl clearance is more than 0.014 inch, move one or more spacing washers from outside of 50-kc bearing collar to inside of 50-kc bearing collar; this adjusts 50-kc clutch away from front gear plate and allows less pawl clearance. Recheck pawl clearance whenever spacing washers are moved from one side to other side of 50-kc bearing

collar. Shifting of spacing washers from one side to otherside of 50-kc bearing collar adjusts pawl clearance. Do not change total number of spacing washers to adjust clearance.

(56) Remove front gear plate from spacer posts.

(57) Mount spacing washers (35) on mc clutch shaft (43) placing same amount of washers on inside of mc bearing collar (21) as noted on disassembly section (paragraph 7.F.(12)). If it is not known what number was removed, mount six washers.

(58) Lubricate mc bearing collar with one drop of MIL-L-6085A. Remove any excess.

(59) Mount mc bearing collar on front gear plate with two screws (22) and two lock washers (23). Mount hub of mc bearing collar toward front gear plate.

(60) Temporarily mount front gear plate to spacer posts.

(61) Mount spacing washers (20) on mc clutch shaft, placing same amount of washers on outside of mc bearing collar as noted on disassembly section (paragraph 7.F.(12)). It is not known what amount was removed, mount six washers.

(62) Mount flat washer or washers (19) on mc clutch shaft.

(63) Mount retaining ring (18) on mc clutch shaft.

(64) Check end play of mc clutch for a maximum of 0.033 inch. If end play is greater than 0.003 inch, add spacing washers (20) on outside of mc bearing collar until end play is 0.003 inch or less. Total number of spacing washers adjusts end play.

(65) Push mc pawl (62) toward mc solenoid (72) as far as possible so that mc pawl is in energized position.

(66) Check that clearance between mc pawl tip and surface of mc notch wheel is 0.004 to 0.014 inch. Adjust clearance of pawl tip as for 50-kc pawl in step (55), using spacing washers (35).

(67) Secure front gear plate to spacer posts.

(68) Mount collar (14, 17) on mc clutch shaft.

(69) Mount collar (12) on blanking shaft (132).

(70) Rotate switch segments of switch A1S8 (9) so that indentation in switch segments (figure 501) is in same position on both segments and mount switch on collar step (73).

(71) Mount retaining ring (11) on blanking shaft.

(72) Mount retaining ring (10) that holds switch A1S8 to front gear plate.

(73) Mount motor A1B1 (3, 8) to front gear plate with three screws (4) and three lock washers (5). Mesh motor gear with 50-kc and mc clutch gears (51).

(74) Remove retaining ring (85) that is closest to 38-tooth loading gear (84, 85).

(75) Separate 38-tooth loading gear from differential loading gear (79).

(76) Place subassembly so that motor A1B1 (3, 8) is toward repairman.

(77) Note position of end of torsion spring (89) in 38-tooth loading gear.

(78) Rotate 38-tooth loading gear one turn counterclockwise (as viewed from front of subassembly) using position of end of torsion spring as a reference point. This loads torsion spring to approximately eight inch-ounces.

(79) Mesh 38-tooth loading gear with differential loading gear, being careful that torsion spring load is not lost.

(80) Mount retaining ring (85) next to 38-tooth loading gear. Rotate segments of switch A1S8 (9) so that segments are positioned as shown in figure 501, detail B.

(81) Liquid stake and tighten two setscrews (13, 125) in collar (12). Check that front segment of A1S8 is still positioned as shown in figure 501 after tightening setscrews.

(82) Place subassembly so that switch A1S4 (103) is toward repairman and in upper left hand corner.

(83) Rotate split shaft of 42-tooth gear (110) counterclockwise so that rear outside and rear inside segments of A1S4 are positioned as shown in figure 501. Positioning of switch in a counterclockwise direction removes some of backlash from gear system.

(84) Check that segment of A1S5 is positioned as shown in figure 501.

(85) Note that 42-tooth gear (110) has a slight amount of play. Rotate 42-tooth gear counterclockwise slightly so that play is out of gear. Hold 42-tooth in counterclockwise position, liquid stake and tighten two setscrews (109) on collar (108). Check that A1S4 is still positioned correctly.

(86) Rotate segments of switch A1S9 (125) counterclockwise, A1S9 toward repairman so that rear outside and rear inside segments are positioned as shown in figure 501.

(87) Check that rear outside and rear inside segments of switch A1S7 (129) are positioned as shown in figure 501.

(88) Mount collar (14, 17) on mc clutch shaft. Position collar so that pin in collar is vertical, motor A1B1 (3, 8) facing repairman and switch A1S8 (9) at bottom and one setscrew is toward nearest side of subassembly.

(89) Liquid stake and tighten two setscrews (15) on collar (14, 17).

(90) Reconnect spring from follower arm pin (77) to pin (32).

(91) Mount collar (119, 123), liquid stake, and tighten two setscrews (120). Check that rear outside segment of A1S9 is still positioned as shown in figure 501.

(92) Adjust contacts of A1S10 and A1S11 (56) by the following procedure:

CAUTION: ADJUST STATIONARY CONTACTS ONLY. DO NOT ADJUST CONTACTS THAT HAVE PLASTIC PIN THROUGH THEM. USE A SMOOTH-JAWED PLIERS AND ADJUST AT CENTER OF CONTACT ARMS.

(a) Check that 50-kc pawl and mc pawl are seated fully in respective notch wheels.

(b) With both pawls seated fully in notch wheels, check that there is a 0.020-inch minimum gap between pair of contacts on switch A1S10 that is closest to motor A1B1 and between pair of contacts on switch A1S11 that is closest to motor A1B1. (Pairs of contacts on A1S10 and A1S11 that are closest to motor A1B1 are receiver muting contacts.)

(c) With both pawls seated fully in notch wheels, check that there is a 0.020-inch minimum gap between pair of contacts on switch A1S10 that is farthest from motor A1B1 and between pair of contacts on switch A1S11 that is farthest from motor A1B1. (Pairs of contacts on A1S10 and A1S11 that are farthest from motor A1B1 are motor starting contacts.)

(d) Pull mc pawl slowly out of its notch wheel and check that pair of contacts on switch A1S10 that is farthest from motor A1B1 (motor starting contacts) do not close until mc pawl tip is approximately 25 percent of thickness of notch wheel from clearing teeth of notch wheel.

(e) Repeat step (d) for 50-kc pawl and pair of contacts on switch A1S11 that is farthest from motor A1B1 (motor starting contacts).

(f) Check that both pawls are seated fully in their respective notch wheels.

(g) Pull mc pawl slowly out of its notch wheel and check that pair of contacts of switch A1S10 that is closest to motor A1B1 close before pair of contacts of switch A1S10 that is farthest from motor A1B1. (Receiver muting contacts should close before motor starting contacts close.)

(h) Repeat step (g) for 50-kc pawl and contacts of switch A1S11.

(93) Perform the following run-in operation:

(a) Connect Autopositioner subassembly to 51X-2 chassis and connect receiver to an appropriate test setup that will allow channeling to several different frequencies in kc range and even frequencies in mc range.

(b) Loosen two screws (104) that hold switch A1S4 (103) and switch A1S5 (107) to rear gear plate.

(c) Tighten two screws (104) while 50-kc Autopositioner is operating. Check that there is no bind between switches in step (b) and 42-tooth gear shaft (110).

(d) Loosen two screws (126) that hold switch A1S9 (125) and switch A1S7 (129) to rear gear plate.

(e) Tighten two screws (126) while mc Autopositioner is operating. Check that there is no bind between switches in step (d) and shaft of backlash gear and mc drive gear (130).

(f) Channel Autopositioner subassembly to several different 50-kc frequencies and check that 50-kc Autopositioner sets up. If 50-kc Autopositioner does not set up, channel subassembly to .00 mc and check positioning of segments of switch A1S4 and segment of switch A1S5 (figure 501). If setting of switches is not correct, backlash in gear system has not been removed. Loosen setscrews on collar (100), repeat steps (89), (90), and (91), and perform run-in operation again.

(g) Channel Autopositioner subassembly to several different mc frequencies and check that mc Autopositioner sets up. (Mc Autopositioner will set up on even mc frequencies since switch A1S6 is not connected to gear system.) If mc Autopositioner does not set up, channel subassembly to 108 mc and check positioning of segments of switch A1S9 (figure 501). If setting of switch is not correct, loosen setscrews on collar (119, 123), repeat steps (92) and (93), retighten setscrews on collar, and perform run-in operation again.

(h) Channel Autopositioner subassembly to 108.00 mc after run-in operation has been completed.

(i) Remove Autopositioner subassembly from test setup.

B. Replacement of Autopositioner Subassembly in Chassis.

NOTE: Do not mount r-f subassembly and variable i-f subassembly before replacing Autopositioner subassembly.

(1) Slide Autopositioner subassembly into module frame.

(2) Mount Autopositioner subassembly hold-down screws (11, figure 102) and replace retaining ring on hold-down screw.

(3) Apply Glyptal to threads of screws not held by lock nuts or lock washers.

(4) Mount four screws (5, figure 102), eight screws (4, figure 101), and two screws and lock nuts (5, figure 101).

C. Synchronize Autopositioner Subassembly.

(1) Slide i-f subassembly into chassis, and slide cam shaft through differential cam and kc drive gear. Make sure that mc dial drive shaft engages collar. Mount subassembly to module frame. Refer to paragraph 2.E. and figure 501.

(2) Replace r-f subassembly to module and connect two loading springs on coupler. Refer to paragraph 2.G.

(3) Prior to synchronizing switches S1 through S9, make sure that the following conditions exist:

(a) Setscrews of all switch clamping collars are loose.

(b) Kc and mc pawls are fully engaged in any of the stop-wheel notches.

(c) Zero backlash exists between mc dial drive shaft and first oscillator drive shaft and their respective drive collars. Pinch forked ends of shaft to obtain these conditions when reassembling if necessary.

(4) Synchronize switches S1 through S9 as follows:

NOTE: Tighten switch collar setscrews on segment of split hub rather than on split.

(a) Visually align switch S4 and S5 as shown in figure 501. This corresponds to a kc dial reading of 00 kc; make certain that kc drive gear (110) and its retaining ring do not limit shaft (53) end play. Tighten left setscrew (viewed from front of assembly) of kc drive gear clamping collar (108).

(b) Position kc follower assembly (77) on lowest operating point of cam. This is not the extreme low point, but the point at which follower is positioned after dropping from high point of cam. Position gear to allow 0.01-inch nominal end play of cam shaft and fully tighten setscrews on clamping collars.

(c) Visually align rotor of S6 as shown in figure 501. Laterally position S6 switch drive collar (117) so that cam shaft end play is not limited. Tighten collar (117) setscrews.

(d) Nominally center the 00 position in bearing plate aperture with kc dial. Position riveted dial drive cam arm from point of dial cam (first low point reached when rotating cam counterclockwise as viewed from front of unit). Mesh switch drive with dial cam drive gear and gear on kc cam shaft (53). Adjust nominal lateral full mesh. Tighten setscrews of clamping collar as shown in figure 501.

(e) Loosen collar clamp (78) on rear of differential (79) and adjacent tuning capacitor so rotor plates fully engage stator plates. Position one setscrew of collar on bottom and the other setscrews toward inside. Adjust lateral position of differential output shaft to allow 0.01- to 0.015-inch end play in differential frame. Tighten both setscrews on differential clamp.

(f) Loosen differential cam clamping collar (78) and position cam so that follower arm just clears the high point of cam and rests on lowest operating point of cam. This is not the extreme low point, but the point at which cam follower is positioned after dropping from the high point of cam. Tighten setscrews of cam clamping collar.

(g) Visually align rotors of switches S7 and S9 as shown in figure 501, detail A. This corresponds to an mc dial setting of 108 mc. Tighten bottom setscrew on mc drive shaft collar as shown. Be sure that mc drive gear and its retaining ring do not limit shaft (43) end play.

(h) After alignment of S7 and S9, and prior to replacing cover, align switch rotor tab of S3 as shown in figure 501. Tighten switch drive collar.

(i) Nominally center mc dial to 108 mc in bearing plate aperture. Seat mc dial shaft drive collar against retaining ring and tighten setscrews.

(j) Visually align rotor of S8 as shown in figure 501, detail B. Tighten switch drive collar setscrew.

(k) Adjust Autopositioner contacts (49) so that the following conditions exist:

CAUTION: ADJUST ONLY THE STATIONARY CONTACTS (60, 64) USING SMOOTH-JAWED PLIERS AND ADJUST AT THE CENTER OF THE ARMS.

1. A 0.02-inch minimum gap exists between contacts when solenoid (72) is de-energized and pawl tip (69) is fully seated in a notch in stop wheel (45, 55).

2. Motor starting contacts (60, 62) are closed when the pawl tip is resting on face of stop wheel (surface between notches) and are open with a maximum of 25 percent engagement of a notch.

3. A 0.015-inch minimum over-travel (follow-up) exists when solenoid is in the fully energized position.

4. Receiver muting contacts (64, 66) close at the same time or prior to motor starting contacts (60, 62). Be sure that end play of mc clutch (36) is not limited by collar (14). Position drive gear (130) in the center of its end play before tightening collar (14).

(l) Connect r-f unit to 51X-2 receiver and apply power. Cycle each Autopositioner switch in turn, and note that front switch (64, 66) on each switch stack closes first. If these switch sections do not operate properly, recheck contact adjustment as given in the synchronization procedure above.

(m) Check that the pawl enters the stop wheel at each 50 kc and each mc channel. The muting switch (64, 66) should open when pawl enters stop wheel, and close when motor is running.

(5) If Autopositioner appears to be synchronized improperly, break the primary power input at the point where dials indicate 108.00 mc and pawls have engaged stop wheels. Check S4, S5, S6, S7, S8, and S9 switch stators and rotors for orientation in accordance with figure 501. If readjustment is required, make sure when retightening clamping collars that end play is not limited by the collars.

(a) Starting from 108.00 mc, cycle the kc Autopositioner so that the inaccessible setscrew of kc gear clamping collar can be reached and tightened.

(b) Starting from 108.00 mc, cycle the mc Autopositioner so that the inaccessible setscrew of mc drive shaft collar can be reached and tightened.

(c) Cycle receiver to 151.95 mc. Loosen top screw on differential clamp (refer to figure 107), and readjust position of tuning capacitor shaft so index on coupler lines up with index on capacitor.

(d) Connect module in test setup, and inject a 151.95-mc signal into set. Obtain an agc reading of 3 volts. Rock tuning capacitor C2 back and forth until a peak reading is obtained. Keep agc level below 3 volts by reducing the input to the receiver while making adjustment. Adjust lateral position of differential output shaft to allow 0.01- to 0.015-inch end play in differential frame. Make sure clamp is not limiting end play.

D. Reassemble Variable I-F Subassembly.

NOTE: Use new retaining rings if retaining rings were bent on removal.

(1) Lubricate the following with Molykote-Type G. Remove any excess.

(a) Working surfaces (surface that guide pin rides on) of tuning table cams (figure 102).

(b) Front guide slot (figure 102).

(c) Working surface of odd-even cam (figure 105).

(2) Lubricate all bearings and bores of gears that idle on shafts with one drop of MIL-L-6085A. Remove any excess.

(3) Position slug rack slugs in coil forms and position front guide pin in front guide slot (figure 102).

(4) Mount cam shaft (figure 102) in Oilite bearing in bracket positioning cam shaft so that cam pins ride on tuning table cams.

(5) Attach two extension springs to slug rack.

(6) Mount odd-even cam gear and odd-even cam on bracket shaft (figure 105).

(7) Mount retaining ring on bracket shaft that holds odd-even cam and odd-even gear.

(8) Check that odd-even cam and odd-even cam gear rotates freely.

(9) Mount idler arm (figure 106) part way in bracket.

(10) Apply blue varnish to two setscrews on cam arm.

(11) Mount cam arm (figure 105) on idler arm by positioning guide pin in cam arm so that it fits grooves in idler arm.

(12) Mount two retaining rings on idler arm, one on each side of bracket.

(13) Slide cam arm fully on idler arm, setting cam arm pin on odd-even arm.

(14) Replace large retaining ring (figure 105) that holds cam arm on idler arm.

(15) Pull cam arm away from bracket so that cam arm pin is fully seated on odd-even cam.

(16) With cam arm pin fully seated on odd-even cam, tighten two setscrews on cam arm.

(17) Mount dial drive shaft and dial drive gear (figure 106) on bracket.

(18) Replace small retaining ring that holds dial drive shaft.

(19) Assemble and mount 26-tooth split gear (figure 106) as follows:

(a) Place one of the gears so that smooth side is up.

(b) Place one end of spring in hole in gear step (a).

(c) Place second gear, smooth side up, on top of first gear in step (a) with other end of spring in hole in second gear. The spring fits into grooved side of second gear.

(d) Hold first gear stationary and rotate second gear so that holes in both gears go toward each other.

(e) Rotate second gear until there is a slight tension on the spring. Then rotate the second gear two additional teeth, holes toward each other.

(f) Mount 26-tooth split gear on its idler arm shaft, meshing 26-tooth split gear with dial drive gear. Make sure that spring tension is not lost.

(g) Replace retaining ring that holds 26-tooth split gear.

(20) Rotate A1S1 so that switch tab is at A1Y1 (figure 106). This corresponds to a .00-mc setting.

(21) Rotate dial drive shaft (figure 105) so that split in shaft is vertical.

(22) Apply blue varnish to two setscrews on 1-f crystal oscillator gear collar (figure 105).

(23) Mount dial shaft far enough in Oilite bearing to mount 1-f crystal oscillator gear and collar on dial shaft. Do not mesh any gears and do not tighten setscrews on collar.

(24) With 50-kc dial toward repairman and subassembly setting upright, rotate 50-kc dial so that .00-mc reading is at approximate left horizontal position.

(25) Without meshing any gears, check that flat parts of dial shaft are positioned approximately correct for placement in switch A1S1 double-D hole. The dial shaft controls the setting of the 50-kc dial only.

(26) With 50-kc dial and dial shaft positioned as in (24) and (25) above, rotate mc dial so that 108-mc reading on mc dial is lined up with .00-mc reading on 50-kc dial.

(27) Push mc dial and 50-kc dial in while meshing 26-tooth dial gear (figure 105) with 26-tooth split gear (figure 106). Check the following after meshing gears.

(a) Split end of dial drive shaft is vertical (step (21)).

(b) Tab of switch A1S1 is positioned at A1Y1 (step (20)).

(c) Mc dial reading of 108 mc is lined up with .00-mc reading on 50-kc dial (step (26)).

(28) Mount plate (figure 105) on posts.

(29) Mount three retaining rings on posts.

(30) Check that 108-mc reading and .00-mc reading are centered in plate window. Slightly adjust dials, if necessary, to line up readings correctly. Do not rotate 50-kc dial too far so that tab of A1S1 is not positioned at A1Y1.

E. Replace Variable I-F Subassembly in Chassis.

(1) Replace Autopositioner subassembly (paragraph B) if it has been removed.

(2) Lubricate rear guide slot on Autopositioner subassembly front gear plate (figure 101) with Molykote-Type G.

(3) Check that 1-f crystal oscillator gear (figure 102) is loose on shaft and is not meshed with odd-even cam gear or with 68-tooth gear. Loosen setscrews on 1-f crystal oscillator gear collar and unmesh gears if necessary.

(4) Check that mc dial reads 108 mc in plate window.

(5) Check that split end of dial drive shaft is vertical.

(6) Pinch split end of dial drive shaft slightly.

(7) Loosen two setscrews on collar (14, 17, figure 107) on Autopositioner subassembly.

(8) Rotate collar in step (7) so that pin in collar is vertical when one setscrew is toward bottom of module frame and other setscrew is toward nearest side of module frame.

(9) Attach spring on follower arm to pin on front gear plate of Autopositioner subassembly.

(10) Place 84-tooth gear and gear collar between front and rear gear plates of Autopositioner subassembly, hub of 84-tooth gear towards front gear plate, and gear collar mounted on hub. Place other side of 84-tooth gear against rear gear plate.

(11) Pull follower arm toward side of module so that spring is extended.

(12) Slide subassembly just far enough into module frame so that cam shaft is inserted in its associated Oilite bearing on front gear plate and follower arm is held by cam shaft.

(13) Hold follower arm against side of module frame and mount follower arm cam and cam shaft collar on cam shaft (figure 102), hub of follower arm cam toward rear gear plate of Autopositioner subassembly and cam shaft collar mounted loosely on hub. Follower arm should be between rear gear plate and follower arm.

(14) Release follower arm so that pin on follower arm rests on follower arm cam.

(15) Hold 84-tooth gear so that it meshes with 42-tooth gear (102, figure 107) and slide subassembly in so that 84-tooth gear mounts on cam shaft.

(16) Push subassembly all the way in, noting the following:

(a) Cam shaft is positioned in associated Oilite bearing in rear gear plate of Autopositioner subassembly.

(b) Switch A1S6 collar (figure 102) is mounted on cam shaft.

(c) Split end of dial drive shaft is positioned in collar (14, 17, figure 107). If pin in collar is not positioned correctly for inserting dial drive shaft, rotate collar slightly so that collar pin lines up correctly. Keep collar setscrews positioned towards bottom and nearest side of module. Do not tighten setscrews.

(d) Rear guide pin on variable i-f subassembly is positioned in rear guide slot on Autopositioner subassembly front gear plate.

(e) Three pins mounted on Autopositioner subassembly front gear plate mount into two positioning holes and one positioning slot on variable i-f subassembly bracket.

(17) Mount six screws (3, figure 101) and one screw (10, figure 102).

(18) Connect A1P6 to A1J6 (figure 102).

(19) Mount clamp that holds A1P6 and A1J6 to module frame with two screws (3, figure 102).

(20) Connect A1P4 (figure 102) to A1J4.

(21) If r-f subassembly is mounted in module frame, connect A1P3 (figure 102) to A1J3 on r-f subassembly.

(22) Mount two variable i-f subassembly hold-down screws (4, figure 102) and replace retaining rings on hold-down screws.

(23) Perform the synchronization procedures in paragraph 2.C.

F. Reassemble R-F Subassembly.

NOTE: Use new retaining rings if retaining rings were bent on removal.

(1) Lubricate Oilite bearings in bracket that split drive shaft and h-f switch shaft are mounted in. Use one drop of MIL-L-6085A and remove excess.

(2) Place short end of h-f switch shaft in its Oilite bearing.

(3) Mount spacing collar associated with h-f switch shaft on shaft on opposite side of bracket from h-f switch gear (figure 104). Place hollow side of spacing collar next to bracket (towards gear).

(4) Mount retaining ring on h-f switch shaft next to spacing collar in step (3).

(5) Place split end of split shaft in its Oilite bearing.

(6) Mount spacing collar on split drive shaft on opposite side of bracket from drive gear (figure 104). Place hollow side of spacing collar next to bracket (towards gear).

(7) Mesh drive gear with h-f switch gear.

(8) Mount retaining ring on split drive shaft next to spacing collar in step (6).

(9) Rotate h-f switch shaft and check for bind on h-f switch shaft and split drive shaft.

(10) Mount r-f tuner A1Z1 board (figure 104) on h-f switch shaft and push board on two top posts.

(11) Solder A1TP3 wire (figure 104) to r-f tuner A1Z1 board.

(12) Solder wire at r-f tuner A1Z1 board that connects with A1C47 (figure 104).

(13) Solder wire at r-f tuner A1Z1 board that connects with pin 4 of A1XV5 (figure 104).

(14) Note position of indentation on contact arm of r-f tuner A1Z1 board. (Indentation can be positioned straight down for each reference.)

(15) Position indentation on contact arm of switch A1S2 coil board (figure 104) and indentation on contact arm of switch A1S3 crystal board (figure 104) so that they are in same position as indentation on contact arm of r-f tuner A1Z1 board in step (14).

(16) Mount two spacers that go between r-f tuner A1Z1 board and switch A1S2 coil board.

(17) Mount three spacers on screws on r-f tuner A1Z1 board.

(18) Apply blue varnish to threads on three screws in step (17).

(19) Mount switch A1S2 coil board on h-f gear shaft. Position three screws on r-f tuner A1Z1 board in step (17) in holes on switch A1S2 coil board.

(20) Mount three spacing posts on screws that extend through switch A1S2 coil board from r-f tuner A1Z1 board in step (19).

(21) Solder wire at switch A1S2 coil board that connects A1R19 with coil board.

(22) Solder wire at switch A1S2 coil board that connects pin 6 of A1XV5 to coil board.

(23) Mount four screws and four flat washers (1, figure 103). Apply blue varnish between washers and screw heads before tightening screws.

(24) Check that indentation on conact arm on switch A1S2 coil board is in same position as indentation on r-f tuner A1Z1 board. Adjust position of A1S2 contact arm if necessary.

(25) Mount switch A1S3 crystal board (figure 104) on h-f gear shaft. Position crystal board on three spacing posts in step (20).

(26) Mount three retaining rings on spacing posts that hold switch A1S3 crystal board in step (25).

(27) Solder two wires to switch A1S3 crystal board (figure 103).

(28) Mount switch drive collar (figure 103). Do not tighten setscrews.

(29) Mount retaining ring that holds switch drive collar.

G. Replace R-F Subassembly in Chassis.

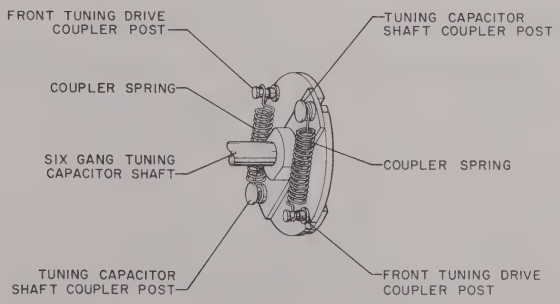
(1) Replace Autopositioner subassembly (paragraph 2.B.) if it has been removed.

(2) Pinch split end of split drive shaft slightly.

(3) Rotate split drive shaft so that split end of shaft lines up with pin in collar (111, 115, figure 107).

(4) If setscrews on collar (67, figure 107) are tightened, loosen setscrews.

(5) Slide subassembly into module frame, inserting split end of split drive shaft into collar in step (4) and inserting posts on tuning capacitor shaft coupler (figure 104) into slots in front tuning drive coupler (figure 502).



Coupler Spring Mounting Diagram
Figure 502

(6) Mount four screws (2, figure 101) and three screws (1, figure 102).

(7) Connect two springs from tuning capacitor shaft coupler to front tuning drive coupler as shown in figure 502. (Spring hookup for receiver and transmitter is the same.)

NOTE: Improper replacement will result in excessive play between couplers. Rotate couplers as necessary to make springs accessible.

(8) Connect A1P2 (figure 102) to A1J2.

(9) Connect A1P5 to A1J5 (figure 102).

(10) Mount clamp that holds A1P5 to A1J5 to module frame with two screws (1, figure 101).

(11) Mount two r-f subassembly hold-down screws (2, figure 102).

(12) Mount retaining rings on two hold-down screws.

(13) If variable i-f subassembly is mounted, connect A1P3 (figure 102) to A1J3.

(14) Perform synchronization procedure in paragraph 2.C.

3. LUBRICATION.

The r-f and variable i-f module is the only module requiring lubrication. Some parts are lubricated for the life of the unit and some parts must not be lubricated.

A. Recommended Lubricants.

Use the lubricants, or their equivalents, specified in table 501.

TABLE 501. RECOMMENDED LUBRICANTS

CODE	MILITARY SPECIFICATIONS	SUGGESTED MANUFACTURER AND TYPE NO.	COLLINS PART NUMBER
A	MIL-L-7870	ESSO Aviation Instrument Oil, Esso Standard Oil Co., New York 19, N. Y.	005-0116-00
B*		2.5 parts by volume of N-Butyl alcohol. 2.5 parts by volume of Xylene. 5.0 parts by volume (Cont)	005-0613-00

*It is recommended that a thin layer of this lubricant be applied at normal times of overhaul and maintenance. DO NOT permit lubricant to come in contact with wire insulation, thermal plastics, or painted surfaces. Prior to use, remove lubricant that previously had been used on the contacts.

TABLE 501. RECOMMENDED LUBRICANTS (Cont)

CODE	MILITARY SPECIFICATIONS	SUGGESTED MANUFACTURER AND TYPE NO.	COLLINS PART NUMBER
		(Cont) of MIL-L-6085A oil which is known and manufactured under various trade names; e.g., Univis P-38 manufactured by Esso Standard Oil Company, 15 West 51st St., New York 19, New York.	
C		Molykote-Type G, the Alpha Corp., Greenwich, Conn.	005-0334-00

B. Parts to Be Lubricated.

Listed in table 502 are the surfaces of the 51X-2 requiring lubrication.

TABLE 502. LUBRICATION POINTS

PARTS LUBRICATED AT INTERVALS OF 10,000 TUNING CYCLES	LUBRICANT	QUANTITY
Working surfaces of the cams	C	Thin film
Tuning table guide slots	C	Thin film
Bores of gears that idle on shafts	A	One drop
Porous bronze bearings	A	One drop
PARTS LUBRICATED AT INTERVALS OF 25,000 TUNING CYCLES		
S1 through S9	B	Thin film on rotor contact paths. Avoid excess.

NOTES

Access to lubrication points may be gained by the removal of covers; further disassembly is unnecessary.
If any item requiring lubrication is disassembled, it should be relubricated upon reassembly.

(8) Hewlett-Packard 200AB Audio Oscillator.

(9) Hewlett-Packard 410B VTVM.

(10) D-c vtvm.

(11) Oscilloscope.

(12) Collins Receiver 51J.

(13) A-c wattmeter, 50 w.

(14) D-c ammeter, 5 amp.

(15) Hewlett-Packard 400C VTVM.

(16) Boonton 211A Signal Generator.

C. Nonoperational Check.

(1) Measure the resistance from the following rear pins to ground with an ohmmeter. Resistances should be approximately as specified.

TABLE 701 RESISTANCE MEASUREMENTS FOR PLUG 1 OF MAIN FRAME MODULE

PIN NO	RESISTANCE	
	D-C SUPPLY	A-C SUPPLY
2	12 ohms	2000 ohms
28	infinite	22 ohms
23	280 ohms	280 ohms
4	infinite	infinite
5	infinite	infinite

(2) Measure the resistance from the + terminal of C2 of the main frame to ground. This resistance should be approximately 15K ohms.

D. Operational Check.

(1) Apply power to receiver, checking for dark or overly bright filaments. Note that a-c power requirement is about 25 watts, and d-c current (when using a-c supply) is less than 0.1 ampere except during channeling when it may rise to about 2.2 amperes. With d-c power supply, note that d-c current drain is about 1.1 amperes rising to approximately 3.3 amperes when channeling.

(2) Check that the pawl enters the stop wheel at each 50-kilocycle and each megacycle channel. The muting switch should open when the pawl enters the stop wheel and close when the motor is running.

(3) Check that top leads of capacitors C13 and C15 of the i-f and audio module are grounded from 108.0 mc to 117.95 mc.

(4) Check that 27.5 v exists on pin 19 of P1 of the main frame from 118.0 to 151.95 mc.

E. Sensitivity Test Requirements.

(1) Adjust the receiver frequency to 108.00 mc, and connect the Hewlett-Packard 608D Signal Generator to the receiver antenna input through a 6-db matching pad. Set SQUELCH control for maximum gain.

(2) Set the signal generator output to 3 uv, and adjust the generator frequency to give an i-f frequency of 500 kc as indicated by a 51J loosely coupled to A2V3. If a 51J receiver is not available, tune the signal generator for maximum agc voltage at TP5 on the i-f and audio module using a vtvm.

(3) Adjust the signal generator for 30 percent modulation at 1000 cps.

(4) Connect a 500-ohm audio load to the audio output terminals, and adjust the AURAL LEVEL control (R18) for 100-mw output.

(5) Remove the 1000-cps modulation, and note the audio output level. Record the decibel drop in audio level as the (S+N)/N ratio.

(6) Record the squelch threshold in microvolts.

(7) Repeat steps (1) through (6) for each of the following frequencies: 109.0, 112.1, 115.2, 118.4, 121.45, 124.5, 127.55, 130.6, 134.65, 137.7*, 140.75, 143.8, 146.85, 149.9, and 151.95 mc. Limits: Not less than 6 db (S+N)/N ratio, squelch threshold 0 microvolt (opens on noise).

F. Selectivity Test Requirements.

(1) With the Hewlett-Packard 608D Signal Generator connected to the receiver antenna input, through a 6-db pad, adjust the generator output to 127.5 mc and 2 uv, no modulation.

(2) Set the receiver SQUELCH control for maximum sensitivity, and connect the vtvm to TP5 on the i-f and audio module.

(3) Loosely couple Receiver 51J to the 500-kc output.

(4) Adjust the signal generator frequency so as to obtain an i-f frequency of exactly 500 kc as indicated on the 51J using the second harmonic (1000 kc). Note this reference output level as read on the vtvm at TP5.

(5) Adjust the signal generator output level to 4 uv (6 db), and adjust the generator frequency to either side of resonance until the reference vtvm indication noted in step d, is again obtained.

(6) Measure the + and -6 db frequencies with the 51J.

(7) Record the difference between the above frequencies as the total bandwidth. This should not be less than 40 kc, and should be centered around 500 kc.

(8) Adjust the signal generator output level to 2K uv, and repeat steps (5) through (7) for the 60-db points. This should not be more than 77 kc.

*Some sets are purchased with crystal complements that do not include reception frequencies higher than 135.95 mc.

G. AVC Characteristics.

(1) Adjust Hewlett-Packard 608D Signal Generator to 115.00 mc at 5 uv with 30% modulation at 1000 cps.

(2) With the receiver set to 115.00 mc, adjust the signal generator frequency for maximum avc voltage at TP5 on the i-f and audio module.

(3) Adjust the AURAL LEVEL control (R18) for 20 mw output for a zero reference.

(4) Adjust the signal generator output to 100K microvolts, and record the decibel change in output for input level using the output level of 20 mw as a reference. Decibel change should not be more than 4.0 db for 100K.

NOTE: When avc characteristics for audio output have been checked, the avc characteristics for ATCSS output have also been checked. Other channels may be checked in the same manner.

H. Squelch Performance.

(1) Set receiver to 118.00 mc. Rotate receiver SQUELCH control to its extreme counterclockwise position. Tune the Hewlett-Packard 608D Signal Generator to 118.00 mc, and connect to receiver input through a 6-db pad. Increase generator output until squelch just opens. Record level at which the squelch opens.

(2) Decrease the signal generator output 20 db, and push the SQUELCH disable button. Note that the squelch opens.

(3) Repeat step (1) for each of the following frequencies: 120.30, 123.95, 124.30, 129.50, 134.70, 139.90, 140.90, 147.00, 151.95 mc. Limits: Minimum squelch opening point, not less than 25 uv with not more than 6 db variation between any two squelch opening levels. Gain control resistors R25 and R26 are chosen to balance the gain across the band. They may be zero resistance (bus wire).

(4) Set receiver frequency and signal generator to 118.00 mc. Adjust signal generator output to three microvolts, and set the receiver SQUELCH control so that the squelch just opens.

(5) Increase generator output; then slowly decrease output until squelch just closes. Record generator output at this point.

(6) Slowly increase generator output, and record the generator output where the squelch just opens. This should not be more than three decibels open-to-close.

(9) Check that pin 25 of P1 is grounded when the 51X-2 is set to any frequency between 108.0 and 117.95 mc.

I. ATC Output.

(1) Set the receiver to 115.00 mc, and adjust the Hewlett-Packard 608D Signal Generator for 1000 uv output, 30% modulation at 1000 cps.

(2) Check that the ATC/VOR/LOC potentiometer (R12) on the i-f and audio module is adjusted for 0.5-v output across a 100K-ohm load using a Hewlett-Packard 400C for measurement. Readjust the ATC/VOR/LOC potentiometer (R12) on the i-f and audio module, if necessary.

NOTE: If the 51X-2 being checked is for use with a 344B-1, 344A-1, or 344D-1, Instrumentation Unit, the ATCSS control (R12) should be adjusted for .5V into a 100,000-ohm load using a 1000-uv signal from a Boonton 211A Signal Generator externally modulated 30% with 30 cps at the 114.9-mc crystal position.

J. Audio Response.

(1) Connect 500-ohm load to audio output terminals of receiver. Tune the Hewlett-Packard 608D Signal Generator and receiver to 118.00 mc.

(2) Adjust the AURAL LEVEL control for 100-mw output while feeding in a 1000-uv, 1000-cps, 30% modulated signal.

(3) Measure the response at the following frequencies: 120, 300, 1000, 3750, and 5750 cps; then vary the modulation frequency to find the point of maximum output. Record this frequency and its level with respect to the reference level at 1000 cps. Limits: At least -20 db at 120 cps and 5750 cps; not more than 6 db variation between 300 and 3750 cps.

(4) With the receiver and generator tuned to 115.00 mc, adjust audio power to 100 milliwatts with 1000-uv, 1000-cps, 30% modulated signal. Tune receiver and generator to 118.00 mc, and measure the output power for a 1000-uv, 1000-cps, 30% modulated signal. Leave AURAL LEVEL control as set in step (2). The resulting power output should not be more than 50 mw.

NOTE: The 51X-2 is set at the factory for 100 mw of audio output with a 1000-uv signal modulated 30% with 1000 cps at a frequency below 118.00 mc. This setting will give a power output of approximately 40 mw above 118.00 mc in the communications band for 30% modulated signals. This power output may be too high for some installations. If it is, adjust the AURAL LEVEL control, R18, in the i-f and audio module to a level suitable for the particular installation.

K. Audio Distortion.

Measure the distortion at the audio output at 1000 cps using 30% modulation. Use a signal generator output of 1000 uv, and maintain 100 mw output for each condition. There should not be more than 7.5% distortion at 30% modulation.

L. Disabling Circuit.

(1) Connect variable source of d-c voltage to pin 23 of P1 of the main frame.

(2) Starting from a low voltage, increase voltage until receiver becomes disabled. The voltage necessary for disabling the receiver should be not more than 20 v.

M. Spurious Rejection.

(1) Adjust the Hewlett-Packard 608D Signal Generator output to 2 uv at 108.00 mc, and set the receiver to 108.00 mc.

(2) Connect the oscilloscope to the audio output and the vtvm to TP5 on the i-f and audio module.

(3) Tune the signal generator for maximum avc voltage at TP5, and note this avc reference level.

(4) Adjust the signal generator output to 200K uv with 1000 cps, 30% modulation, and search the frequency range 80 to 200 mc for spurious signals which will appear on the oscilloscope.

(5) When a spurious is located, remove the 1000-cps modulation, and adjust the generator output to obtain the same avc reference level noted in step (3).

CAUTION: BE CERTAIN THAT THE SPURIOUS RESPONSE IS NOT DUE TO A SPURIOUS OUTPUT OF THE GENERATOR. WITH SOME EXPERIENCE, IT IS POSSIBLE TO DISTINGUISH THESE SPURIOUS RESPONSES FROM A TRUE RECEIVER SPURIOUS. WHEN IN DOUBT, CHECK BY USING A DIFFERENT MODEL OF GENERATOR.

(6) Repeat steps (1) to (5) for receiver frequencies as desired. Spurious responses should be 80 db down (20,000 uv).

N. Low Supply Voltage Operation.

(1) Turn off receiver for a sufficient time to allow filaments to cool.

(2) If using d-c supply, adjust voltage to 22 volts, and turn on receiver. Note that a 10-uv, 1000-cps, 30% modulated signal results in audio output. Operate channel selector, and note that Autopositioner sets up properly.

(3) If using a-c supply, additionally adjust voltage to 92 volts, and note that 10-uv signal is passed through receiver and that Autopositioner operates properly.

O. Alternate Power Supply Operation.

(1) Remove the power supply used in the previous tests, and substitute the alternate supply.

(2) Measure sensitivity at 115.2 mc and 127.50 mc as in paragraph 2.E. The limits of the (S+N)/N ratio should be not less than 6 db.

P. Glide Slope Receiver Power.

(1) With power applied to the receiver, measure the d-c voltage from pin 27 of P1 to ground.

(2) Check that the 27.5-v is obtained at each of the frequencies specified below and that the voltage is zero at all other frequencies: 108.1, 108.3, 108.5, 108.7, 108.9, 109.1, 109.3, 109.5, 109.7, 109.9, 110.1, 110.3, 110.5, 110.7, 110.9, 111.1, 111.3, 111.5, 111.7, 111.9 mc.

3. MECHANICAL ALIGNMENT OF DRIVE MECHANISM.

NOTE: Mechanical alignment is not required ordinarily unless r-f and variable i-f module is disassembled.

Refer to figure 501 for preliminary mechanical adjustment. The final mechanical alignment is done as follows after first connecting the r-f and variable i-f module to the remainder of the receiver using a two-foot patch cable.

A. Check that preliminary module synchronization has been made in accordance with figure 501.

B. Connect r-f unit to receiver, and apply power. Cycle each Autopositioner in turn, and note that the front switch on each Autopositioner switch stack closes first. If these switch sections do not operate properly, check contact adjustment as outlined in figure 501.

C. Check that the pawl enters the stop wheel at each 50-kilocycle and each megacycle channel. The muting switch should open when the pawl enters the stop wheel and close when the motor is running.

NOTE: If the control unit used does not channel to 108.00 mc, the receiver may be positioned to 108.00 mc in either of two ways: (1) Ground pin 20, the N wire, of the receiver rear plug and channel the control unit to 136.00 mc. The receiver will set up at 108.00 mc. (2) Insert a mating connector into the rear plug to which only 27.5 volts, ground, and the following jumpers have been connected. Connect pins 6, 8, 17, and 20 (mc control wires A, C, M, and N) and pins 10 and 16 (kc control wires E and L) to ground. Connect together, and leave ungrounded, pins 7 and 9 (mc control wires B and D). Connect together, and leave ungrounded, pins 11, 12, and 13 (kc control wires F, G, and H). If it is desired, other specific frequencies may be utilized in a similar manner by studying the seeking switch charts, figures 701A and 701B.

D. If Autopositioner appears to be synchronized improperly, break the primary power input at the point where the dials indicate 108.00 mc and the pawls have engaged the stop wheels. Check S4, S5, S6, S7, S8, and S9 switch stators and rotors for orientation in accordance with figure 702. If adjustment is required, make sure on retightening clamping collars that end play is not limited by the collars.

E. Starting from 108.00 mc, cycle the 50-kc Autopositioner so that the inaccessible setscrew of the 50-kc drive gear clamping collar can be reached and tightened.

F. Starting from 108.00 mc, cycle the two-megacycle Autopositioner so that the inaccessible setscrew of the two-megacycle drive shaft collar can be reached and tightened.

G. Cycle receiver to 151.95 mc. Loosen top screw on differential clamp (see figure 501), and readjust position of tuning capacitor shaft so the index on the coupler lines up with the index on the capacitor.

Connect the module in a test setup similar to that in paragraph 4.E., r-f alignment, and inject a 151.95-mc* signal into the set. Obtain an agc reading of three volts. Rock the tuning capacitor C2 back and forth until a peak reading is obtained. Keep the agc level below three volts by reducing the input to the receiver while making adjustments. Adjust lateral position of differential output shaft to allow 0.010 to 0.015 inch end play in the differential frame. Tighten both setscrews on the differential clamp. Make sure clamp is not limiting end play.

*Some sets are purchased with crystal complements that do not include reception frequencies higher than 135.95 mc. When one of these sets is encountered and an adjustment frequency of 151.95 mc is called out, use 135.95 mc instead. Adjustment frequencies between 135.95 and 151.95 mc then should be ignored. In this case, inject a 135.95-mc signal into the set, and rock the tuning capacitor back and forth until a peak reading is obtained.

Renumbered figure 702 to figure 501.

4. ELECTRICAL ALIGNMENT OF R-F AND VARIABLE I-F AMPLIFIER.

A. Test Equipment Required.

The following test equipments or their equivalents are required:

(1) Receiver 51X-2 (under text).

(2) Hewlett-Packard Model 410B VTVM.

(3) Boonton Type 202B Signal Generator or Hewlett-Packard 608D.

(4) Frequency measuring equipment.

(5) D-c vtvm.

(6) Frequency control selector such as Collins 614U-1.

(7) Daven Audio Output Meter.

(8) Patch Cable Kit, Collins P/N 545 4966 00.

(9) Special Alignment Tool, Collins P/N 542 4587 002.

B. Conditions.

(1) All tests specified herein shall be conducted under normal ambient conditions.

(2) Power supply voltage: 115 v 300-1000 cps and/or 27.5 v d-c depending upon which power supply module is plugged into the 51X-2.

C. Variable I-F Alignment.

(1) Connect the module to the receiver with the patch cable.

(2) Channel the 50-kc Autopositioner, and check output of all crystals of second oscillator for at least 1.0 v d-c at TP6 and for approximate frequency with a 51J receiver or a counter.

(3) Channel to low end of variable i-f (even +.00 mc). Inject variable i-f signal of 10.025 mc at first mixer grid of sufficient strength to obtain a reading on the agc line. Adjust slugs of L6 through L11 for maximum output.

(4) Channel to high end of variable i-f (odd mc +.95 mc). Inject variable i-f signal of 11.975 mc, and adjust C16, C19, C21, C31, and C36 for maximum output.

(5) Repeat steps (3) and (4) until no further improvement can be made. Always end with step (4). If maximum flatness of gain is desired, recheck slug adjustment at 10.975 mc.

D. Alignment of First Crystal Oscillator.

(1) Set module to 150 mc (134 mc if receiver is not equipped for extended coverage).

(2) With alignment tool, adjust slug of L34 (marked "150") or L26 (marked "134") for maximum d-c output (sharp peak) at TP7.

(3) Channel module to each even megacycle, and adjust slug marked with the appropriate channel frequency for maximum output.

(4) Channel module to 112 mc. Connect vtvm to mixer grid (TP2), and adjust C53 for maximum output.

(5) Channel module to 134 mc (146 mc if equipped for extended coverage). Adjust L37 with an insulated tool for maximum output.

(6) Repeat steps (4) and (5) until no further improvement is obtained. Slightly touch up C53, if necessary, at 134 mc (146 mc if equipped for extended coverage) after completion of alignment procedure.

(7) Loosely couple oscillator to frequency rack. Channel module to each even megacycle, and check frequency of each crystal according to the following table. If frequency is off more than 1000 cps, slightly readjust the appropriate slug of L14 through L35 to put the frequency within this range.

(8) Remove P3 from J3. Channel module to each even megacycle, and check voltages at TP2 with a d-c vtvm. This voltage should be at least one volt. A sudden appreciable drop in d-c voltage measured at TP2 on a channel in the band may indicate a defective crystal or improper synchronization of the Z1 tuner.

CAUTION: DO NOT DETUNE SLUG SO FAR THAT OUTPUT VOLTAGE AT TP7 DROPS MORE THAN 10%.

TABLE 702. CHANNEL VS CRYSTAL FREQUENCY (MC)

CHANNEL FREQUENCY	CRYSTAL FREQUENCY (mc)
108	48.9875
110	49.9875
112	50.9875
114	51.9875
116	52.9875
118	53.9875
120	54.9875
122	55.9875
124	56.9875
126	57.9875
128	58.9875
130	59.9875
132	60.9875
134	61.9875
136*	62.9875
138*	63.9875
140*	64.9875
142*	65.9875
144*	66.9875
146*	67.9875
148*	68.9875
150*	69.9875

* Only in receivers equipped for extended coverage

TABLE 703. BAND VS CRYSTAL FREQUENCY (MC)

BAND	CRYSTAL FREQUENCY (mc)
108-110	48.9875
110-111	49.9875
112-113	50.9875
114-115	51.9875
116-117	52.9875
118-119	53.9875
120-121	54.9875
122-123	55.9875
124-125	56.9875
126-127	57.9875
128-129	58.9875
130-131	59.9875
132-133	60.9875
134-135	61.9875
136-137*	62.9875
138-139	63.9875
140-141	64.9875
142-143	65.9875
144-145	66.9875
146-147	67.9875
148-149	68.9875
150-151	69.9875
*Refer to note in paragraph 3.G.	

B. Sensitivity.

(1) Channel module to 108.00 mc, and connect the signal generator to the antenna input jack. Set SQUELCH control for maximum gain.

(2) Set signal generator output to three microvolts, and adjust generator for maximum agc.

(3) Adjust signal generator modulation to 30% at 1000 cps.

(4) Measure audio output at some point below 100 mw.

(5) Remove modulation, and note audio output level. Record the decibel drop in audio level as the (S+N)/N ratio. It should be not less than six decibels.

(6) Repeat steps (1) through (5) for each of the following frequencies: 108.00, 111.05, 114.10, 117.15, 120.20, 123.25, 126.30, 129.35, 132.40, 135.45, 138.50*, 141.55, 144.60, 147.65, 150.70, and 151.95 mc.

*Refer to note in paragraph 3.G.

C. Squelch.

(1) Squelch Level Adjustment.

CAUTION: BEFORE MAKING ADJUSTMENTS CHECK IF THE SETUP HAS A 10K-OHM LOAD ON PIN 25 OF P1 TO SIMULATE THE SQUELCH POTENTIOMETER IN THE REMOTE BOX. THE PERFORMANCE OF STEP (a).3. IN THE PREFERRED METHOD BELOW IS AFFECTED BY THIS LOAD. REFER TO FIELD SERVICE BULLETIN NO. 21 DATED 9-22-61.

(a) Preferred Method.

1. Tune receiver to some frequency above 118 mc with a 1000-cycle 30 percent modulated signal.

2. Adjust control box squelch control and sensitivity on front of receiver to minimum (counterclockwise rotation).

3. Adjust signal generator for 10 microvolts if external load is used and 25 microvolts if no external load is used.

4. Adjust R37 until receiver just squelches off. (If tubes have normal gain, this control will be set fully clockwise.) Readjust control box squelch control and sensitivity to desired level.

(b) Alternate Method.

1. Tune receiver to any frequency above 118 mc and terminate the antenna input into a 50-ohm load.

2. Turn the sensitivity control on the front of the receiver to maximum gain (clockwise rotation).

3. With no signal input, measure the avc voltage generated by noise at test point TP5. If the voltage is 2.0 volts d-c or less, no adjustment of R37 is necessary. If the avc voltage is more than -2 volts d-c, turn R37 counterclockwise until -2.0 volts avc is obtained.

NOTE: Using either of the above methods, R37 should be set at maximum gain (clockwise) unless adjustment is required as outlined above. If it is necessary to reduce the i-f gain, it may be necessary to turn the control back for maximum gain after the receiver is used for some months and the tubes have aged to the point of normal gain, otherwise squelch may not open on noise.

(2) Squelch Performance.

(a) Channel module to 118.00 mc, and set squelch threshold control to open at 5 uv.

(b) Channel receiver to each of the frequencies listed and record squelch threshold: 118.00, 120.30, 123.95, 124.30, 131.00, 139.90*, 140.90, 147.00, and 151.95 mc.

*Refer to note in paragraph 3.G.

Test limits should not be more than 2-to-1 squelch threshold variation. Resistors R25 and R26 may be changed to improve gain balance across the band. They may be reduced to zero ohms (bus wire).

D. Automatic Volume Control.

(1) Set module frequency at 115.00 mc.

(2) Tune signal generator for maximum agc. Set output for 5 uv 30% modulated at 1000 cps.

(3) Adjust audio gain for not more than 25 mw output for a zero reference.

(4) Adjust the signal generator output to 100K uv, and record the decibel change in output level. Should be not more than four decibels.

6. 500-KC LC PASSIVE FILTER ALIGNMENT.

NOTE: The input and output circuits of the filter are normally the only adjustments required. These adjustments must be made with the filter in the radio as explained in paragraph 8.

The filter has been completely aligned at the factory, using special test equipment, for optimum performance. Complete alignment of the filter should not be attempted in the field unless the filter has been proved defective because of part movement, damage, or repair. The three characteristics, bandwidth, insertion loss, and passband ripple, determine whether a filter is defective. The following checks, with all modules in place, will help localize a defective filter:

A. Insertion Loss.

Check end section tuning per paragraph 8. Make stage gain checks per figure 703, and compare with a good receiver. Replace suspected filter with a good one, and after aligning end sections, repeat stage gain tests. If the suspected filter exhibits a loss 3 db or more than the good filter, the alignment of the filter should be rechecked.

B. Bandwidth.

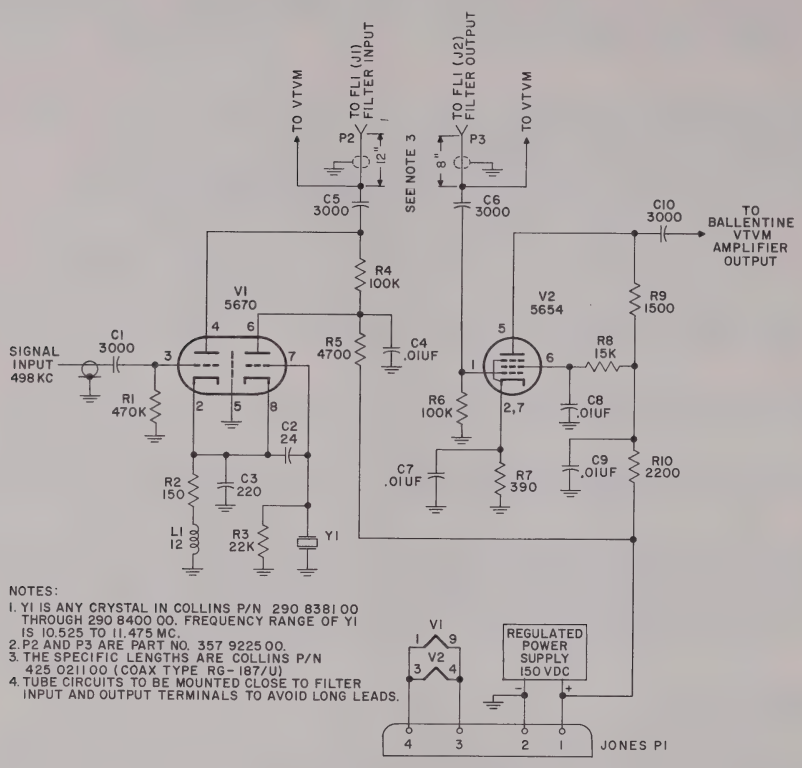
Perform the selectivity test per paragraph 2.F. If the 6-db bandwidth points are out of symmetry by 10 kc or more or the 6-db bandwidth is too wide, the filter may be defective. Substitute a good filter, and after aligning the end sections, recheck the selectivity. If the selectivity has been corrected, then the filter is defective and should be repaired and realigned.

C. Passband Ripple.

Check tuning of end sections. Note the agc voltage variation as measured at TP5 on the i-f and audio module as the frequency of the 608D signal applied to the antenna input is varied across the passband of the filter. The passband ripple is the ratio of the signal input required at a dip in the passband to give the same agc reading as the peak in the passband. If the ripple exceeds 3 db, the filter alignment should be rechecked.

D. Factory Method of Filter Alignment.

This method assures correct alignment; however, the method in paragraph E will give satisfactory results.



Filter Test Jig
Figure 704

(1) Test Equipment Required.

The following test equipments or their equivalents are required:

(a) Filter test jig. See figure 704.

(b) Signal Generator, Measurements Model 65B.

(c) VTVM, Ballantine Model 314.

(d) Receiver, Collins 51J.

(e) Special Alignment Tool, Collins part number 542-4587-002.

(f) Regulated Power Supply, 150 v d-c, Low Ripple.

(2) Test Conditions.

(a) All tests shall be conducted under normal ambient conditions.

(b) All test equipment shall have a 15 minute warmup period.

(c) The noise output of the test jig amplifier shall not exceed 0.002 volt.

(3) Alignment Procedure.

(a) Remove the filter cover and connect the filter input (J1) and the output (J2) to the test jig input and output connectors respectively. Ground the filter case to the test jig chassis.

(b) Turn on power to the test jig. Connect the Ballantine VTVM to the test jig filter input terminals and 65B Signal Generator to the test jig r-f input.

(c) Set the signal generator frequency to 498 kc with the 51J, and adjust its output to give about 3/4 scale reading on the 0.1 volt scale of the vtvm.

(d) Short coil L2 to ground by shorting the exposed coil terminal to the filter base with a small screwdriver.

(e) Adjust coil L1 for a maximum indication on the vtvm using the position of the core nearest the base of the coil.

(f) Remove the screwdriver short at L2 and place at L3.

(g) Adjust coil L2 for a minimum indication on the vtvm using the position of the core nearest the base of the coil.

(h) Repeat steps d through g according to the following table.

TABLE 704. ALIGNMENT SEQUENCE

STEP	SHORTED	COIL TUNED	VTVM INDICATION
1	L2	L1	Max
2	L3	L2	Min
3	L4	L3	Max
4	L5	L4	Min
5	L6	L5	Max
6	L7	L6	Min
7	L8	L7	Max
8	L9	L8	Min
9	L9	L9	Max

(i) Repeat complete procedure steps d through g.

(j) Evaluate the filter according to instructions given in paragraph 7.

E. Alignment Using 51X-2 Modules.

(1) Test Equipment Required.

The following test equipments or their equivalents are required:

(a) Patch Cable Kit, Collins part number 545 4966 00.

(b) Ballantine 314 VTVM.

(c) Measurements Model 65B Signal Generator.

(d) Frequency measuring equipment.

(e) Special alignment tool, Collins part number 542 4587 002.

(f) 51X-2 Receiver in operating condition.

(2) Conditions.

(a) All tests herein specified should be conducted under normal ambient conditions.

(b) The associated test equipment should be allowed a 15-minute warmup period before any tests are performed.

(3) Alignment Procedure.

(a) Remove r-f and variable i-f and i-f and audio modules, and connect with patch cables to main frame.

(b) Remove the filter from the main frame by removing four screws and the two connectors, P2 and P3.

(c) Remove the cover from the filter.

(d) Reconnect P2 and P3, and place filter on frame so that all adjustments are accessible.

(e) Channel the receiver to some frequency higher than 118.00 mc, and inject a 498-kc signal into the second mixer grid at TP5. Adjust SQUELCH control for minimum gain.

(f) Connect Ballantine VTVM to J1.

(g) Turn on power, and adjust signal level until a reading is obtained.

(h) Short coil L2 to ground by shorting the exposed coil terminal to the filter base with a small screwdriver.

(i) Adjust coil L1 for maximum indication on the vtvm using the position of the core nearest the base of the coil (use special alignment tool).

(j) Remove the screwdriver short at L2, and place it at L3.

(k) Adjust coil L2 for minimum vtvm indication using the position of the core nearest the base of the coil (use special alignment tool).

(l) Repeat step (h) through (k) according to table 704.

(m) Evaluate the filter as directed in paragraph 7.

7. EVALUATION OF 500-KC LC PASSIVE FILTER.

A. Evaluation Using Filter Test Jig.

Test setup is the same as used in paragraph 6.D.(3).

(1) Insertion Loss.

(a) Adjust the 65B Signal Generator for a convenient reading on the vtvm decibel scale. Note the reading.

(b) Reconnect the vtvm to the filter output connection, and note the decrease in the vtvm reading. The decrease should be less than 2.5 db.

(2) Bandwidth.

(a) Decrease the signal generator output attenuator to the X100 scale, and reconnect the vtvm to the amplifier output. Set the vtvm to the 0.1-volt scale.

(b) Sweep the passband and locate the point of peak response. Adjust the signal generator output for a vtvm reading of 10 db.

(c) Vary the frequency of the signal generator above and below 500 kc, and determine the frequencies at which the vtvm reads down 4 db with the 51J. The plus and minus 4-db frequencies should be 20 kc or more and the total 4-db bandwidth at least 40 kc.*

(d) Reduce the signal generator attenuator to X10 and the vtvm to the 0.01-volt range. Locate the frequency of maximum response, and adjust signal generator level for a 10-db reading on the vtvm.

(e) Increase the frequency of signal generator at least 40 kc, and adjust the attenuator to X10K. Adjust the signal generator frequency above and below 500 kc until the 10-db reading is obtained on the vtvm. Measure the frequency using the 51J set to the second harmonic.

(f) The plus and minus 60-db half bandwidths as measured in step e should each be less than 46 kc with the sum being less than 82 kc.

(3) Passband Ripple.

(a) Reduce the signal generator output to X100, and increase vtvm to the 0.1-volt range with the vtvm on the amplifier output.

(b) Sweep the frequency range of 500 plus and minus 18 kc, and note the maximum variation of output in db. Should be less than 3 db.

B. Evaluation Tests Using 51X-2 Modules.

The test setup is the same as used in paragraph 6.E.(3).

(1) Insertion Loss.

(a) Adjust the 65B Signal Generator output for a convenient reading on the vtvm db scale. Note the reading.

* If total bandwidth meets requirements at 4 db but plus and minus deviations are not met, realign filter at slightly different frequency in order to make passband more symmetrical about 500 kc.

(b) Connect the vtvm to the filter output connection J2. The decrease in vtvm reading should be less than 2.5 db.

(2) Bandwidth.

(a) Adjust the signal generator step attenuator for a convenient reading on the vtvm connected to J2.

(b) Sweep the passband, and locate the point of peak response.

(c) Vary the generator above and below 500 kc, and determine the frequencies at which the vtvm indication is 4 db down.

(d) Record the two frequencies. The deviation of each should be not less than 20 kc, and the total should be not less than 40 kc.*

(e) Locate the frequency of maximum response, and adjust signal generator input for a convenient reading on the vtvm.

(f) Increase the frequency of the generator by at least 40 kc, and adjust the step attenuator to 1000 times that used in step (e). Adjust the frequency until the reading of the previous step is obtained. Determine and record the frequency of this 60-db point. It should be not more than 46 kc away from 500 kc.

(g) Decrease the frequency, and determine the low side 60-db attenuation frequency. Record this frequency. It should be not more than 46 kc away from 500 kc. The total bandwidth should be not more than 82 kc.

(3) Passband Ripple.

Reduce the generator output attenuator to that of step (c) above, sweep the frequency range of 500 ±18 kc, and record the maximum variation of output in decibels. The peak-to-valley ratio should be not more than 3 db.

8. 500-KC LC PASSIVE FILTER TOUCH-UP.

A. Reassemble the filter and modules into the main frame.

B. Connect the Hewlett-Packard 608D to the receiver input, and tune to the center of any channel. Check by tuning a loosely coupled 51J to 500 kc and adjusting generator frequency for zero beat.

C. Connect a d-c vtvm to TP5 on the i-f and audio module.

D. Tune the slugs of L1 and L9 of FL1 through the access holes in the side of the receiver for maximum vtvm indication.

9. 500-KC MECHANICAL FILTER (Alternate for 500-Kc LC Passive Filter.)

A. Evaluation.

(1) Insertion Loss.

Make stage gain checks per figure 703, and compare with a good receiver. Replace suspected filter module with a good one and repeat stage gain tests. If the suspected

*If total bandwidth meets requirements at 4 db but plus and minus deviations are not met, realign filter at slightly different frequency in order to make passband more symmetrical about 500 kc.

filter exhibits a loss 3 db or more than the good filter, the tuning of the filter should be checked.

(2) Bandwidth.

Perform the selectivity test per paragraph 2.F. If the 6-db bandwidth points are out of symmetry by 10 kc or more or the 6-db bandwidth is not correct, the filter may be defective. Substitute a good filter module, and after aligning the resonating capacitors, recheck the selectivity. If the selectivity has been corrected, then the filter is defective.

(3) Pass-Band Ripple.

Note the agc voltage variation as measured at TP5 on the i-f and audio module as the frequency of the 608D signal applied to the antenna input is varied across the pass-band of the filter. The pass-band ripple is the ratio of the signal input required at a dip in the pass-band to give the same agc reading as the peak in the pass-band. If the ripple exceeds 3 db, the filter alignment should be checked.

B. Alignment.

Inject a 515-kc signal into the second mixer grid (A1TP5) of such amplitude that the avc voltage at A2TP5 is about -3.5 volts. Then tune input and output resonating capacitors A5C1 and A5C2 for maximum negative avc voltage.

10. I-F AND AUDIO MODULE ALIGNMENT.

The i-f and audio module requires little alignment but does require very specific evaluation. This module can be aligned right in the receiver.

A. Test Equipment Required.

The following test equipments or their equivalents are required:

(1) Measurements 65B Signal Generator.

(2) Frequency measuring equipment.

(3) D-c vtvm.

(4) Daven Audio Output Meter.

(5) Hewlett-Packard 400C VTVM.

(6) Measurements Model 82 Signal Generator.

(7) Distortion Meter Hewlett-Packard 330D.

(8) Alignment tool, Collins part number 542-4587-002.

(9) Patch Cable Kit, Collins part number 545-5676-005.

B. Conditions.

(1) All tests herein specified shall be conducted under normal factory ambient conditions.

(2) Power supply voltage; 115 v 300-1000 cps and/or 27.5 v d-c depending upon which power supply module is plugged into 51X-2.

(3) Warmup period: 15 minutes.

C. Preliminary Tests.

Before applying power, disconnect P1, and measure resistance from pin 15 of P1 to ground. This resistance should be approximately 20 ohms. Measure the resistance from pins 6 and 14 to ground. These resistances should be about 30K ohms to 33K ohms respectively. Reconnect P1.

NOTE: For units 36 and below measure the resistance from pin 18 to ground in place of pin 15. Measure the resistance from pins 6 and 17 to ground instead of pins 6 and 14 to ground. See Note 10 of figure 706.

D. Electrical Alignment.

(1) Connect module, and check that tubes light. Set receiver to any convenient channel above 117.95 mc.

(2) Inject 500-kc signal at input of i-f amplifier (TP1) from Measurements 65B Signal Generator, and align transformers T1 and T2 using tuning tool. Connect d-c vtvm to TP5, and adjust cores on top and bottom of T1 and T2 for maximum output.

CAUTION: ADJUST INPUT TO KEEP METER ON 3-V SCALE.

(3) Tune top core (primary) of T3 for maximum output at TP5.

(4) Tune bottom core (secondary) for T3 for minimum output at TP5.

CAUTION: IN ADJUSTING T1, T2, AND T3, TUNE TO THE FIRST RESONANCE ENCOUNTERED AS THE SLUGS MOVE INTO THE COIL.

11. EVALUATION OF I-F AND AUDIO MODULE.

A. Conditions.

The test setup remains the same as in paragraph 9.

B. Selectivity.

(1) Connect Measurements 65B Signal Generator to input of i-f (at TP1). Accurately set the frequency to 500 kc.

(2) Adjust input level to 300 uv, and note reference output level as read on the vtvm at TP5.

(3) Adjust generator output level to 380 uv, and adjust generator frequency to either side of resonance until reference vtvm indicator noted in step (2) is obtained.

(4) Measure the + and -2 db frequencies. These frequencies should not be less than 40 kc apart.

(5) Adjust the signal generator output level to 30,000 uv, and repeat steps (3) and (4) for the 40-db points. The frequencies should not be more than 210 kc apart.

NOTE: If 2-db half bandwidths differ appreciably, repeat alignment paragraph 9.D, using a frequency slightly removed from 500 kc in the direction of the smaller 2-db half bandwidth.

C. Gain.

Adjust signal generator output for 300 uv at 500 kc. The agc voltage at TP5, should be about 2.0 volts.

D. Squelch.

(1) With SQUELCH control on receiver set for maximum gain and signal generator set for 30 percent modulation, measure the input required at 500 kc to just open the squelch and to just close the squelch. The input should not be more than 150 uv.

(2) With SQUELCH control set for minimum gain and signal generator set for 30 percent modulation, measure the input required at 500 kc to just open the squelch. The input should not be less than 4500 uv.

(3) With SQUELCH control set about 1/8 turn from the full clockwise position, note the input required to just open squelch and to just close squelch. The ratio should be not more than three decibels.

E. Noise Limiter.

(1) Set the 65B Signal Generator to 1000 uv output, and connect oscilloscope to TP7.

(2) Modulate the signal generator with 1000 cps, and increase the percentage modulation until clipping is observed on the oscilloscope. Note the percentage modulation at which clipping occurs. It should not be less than 70 percent.

F. Automatic Volume Control.

(1) Adjust the signal generator for 250 uv at 30 percent modulation at 1000 cps.

(2) Adjust AURAL LEVEL control (R18) for 25 mw output into 500 ohms.

(3) Adjust the signal generator to 50,000 microvolts, and record the decibel change in output using the output level of 25 mw as a reference. The output level should not change more than four decibels.

(4) Adjust signal generator to 100,000 microvolts. Cut off signal, and note the rate of voltage drop at TP5 using the vtvm.

(5) Adjust the receiver frequency to any channel below 118.00 mc. Repeat step (4). Note that the rate of voltage drop is considerably slower. This procedure checks the longer time constant that is necessary for VOR operation below 118.00 mc.

G. ATCSS Output Level and Frequency Response.

(1) Connect Hewlett-Packard 400C VTVM to ATCSS output of i-f and audio module.

(2) Connect the Measurements Model 82 Signal Generator to the input of the i-f and audio module (TP1), and adjust for 200 uv and 30 percent modulation at 500 kc. Leave receiver set below 118.00 mc.

(3) Set the ATCSS level potentiometer (R12) for 0.5 v output at 1000 cps.

(4) Measure the voltage output at the ATCSS/VOR output of the receiver (pin 18 of the rear connector) for the modulation frequencies specified below, taking care to keep the modulation percentage at 30 percent. There should be not more than 6 db maximum to minimum.

FREQUENCY (cps)	
30	3,000
100	10,000
300	15,000
1000	22,000

H. Audio Output Level and Frequency Response.

(1) Connect Daven Output Meter to audio output terminals of i-f and audio module.

(2) Inject a signal generator output of 200 uv, 30 percent modulation with receiver tuned above 118.00 mc.

(3) Adjust AURAL LEVEL control (R18) for 100 mw out with 1000-cps modulation.

(4) Measure the response at the following modulation frequencies: 120, 300, 1000, 3750, and 5750 cps. Response should be not less than -20 db at 120 and 5750 cps. From 300 to 3750 cps, the response should vary no more than 6 db.

(5) Readjust AURAL LEVEL control (R18) for 100 mw out at 1000 cps with receiver tuned below 118.00 mc. Channel receiver above 117.95 mc. The decrease in output should be not less than three decibels.

I. Audio Distortion.

(1) Using the 65B Signal Generator and the Hewlett-Packard 330D Distortion Meter, measure the distortion at the audio output using a 1000-cps input, 1000 uv, 30 percent modulation. Maintain 100 mw output. Distortion should be less than 7.5 percent.

(2) Repeat measurements at 400 and 3000 cps using an r-f input of 200 uv. The distortion should be less than 7.5 percent.

NOTE: The 51X-2 is set at the factory for 100 mw of audio output with a 100-uv signal modulated 30 percent with 1000 cps at a frequency below 118.00 mc. This setting gives a power output of approximately 40 mw above 118.00 mc in the communications band for 30 percent modulated signals. This power output may be too high for the particular installation. If it is, adjust the AURAL LEVEL control, R18, in the i-f and audio module to a level suitable for the particular installation.

J. Receiver Disable.

(1) Feed a 1000-uv, 1000-cps, 30 percent modulated signal to the i-f input.

(2) Disable receiver by applying 27.5 v to rear connector pin number 23, and note the following:

(a) Receiver audio disappears.

(b) Agc voltage drops.

(c) ATCSS output disappears.

(d) The 27 v on pin 19 of the rear plug disappears.

K. Adjustment of Transient Blanker Circuit in 516B-3 D-C Power Supply.

(1) Connect an adjustable d-c power supply, capable of adjustment from 20 to 36 volts, to the 27.5-volt input (terminal 2 of P1 of the 51X-2).

(2) Set R3 of the d-c power supply module 516B-3 to full counterclockwise position.

(3) Adjust the input voltage to 34 v d-c.

(4) Rotate R3 clockwise until output voltage drops down to nearly zero. The output voltage will drop sharply at some point in the rotation of R3.

(5) Starting at approximately 20 volts input, raise the input voltage to the 516B-3 until its output voltage drops off sharply. If the output voltage drops off at or near 36 volts and does not show signs of dropping off at 30 to 32 volts input, then R3 needs no further adjustment.

M. Alternate Method 2 of Adjusting Transient Blanker.

This new method makes use of a transient generator of simple construction (see figure 705) which eliminates the need for a variable DC power source. The transient protector circuit of the 516B-3 may be adjusted with the supply operating in the equipment or into a dummy load.

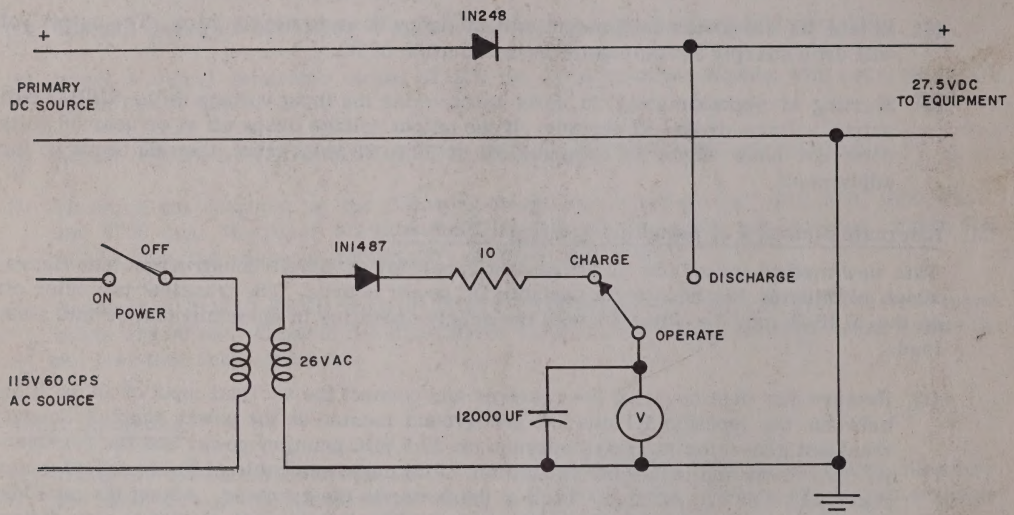
(1) Remove the dust cover of the receiver and connect the vertical input of an oscilloscope between the junction R7 and C2 and ground located on the power supply. Connect the transient generator in series between the 27.5 VDC primary power and the receiver with its operate switch in the charge position. Plug the power cable of the transient generator into a 115 v 60 cps AC line. Turn on the power to the receiver. Adjust the oscilloscope for only a spot in the middle of the screen, with enough vertical gain to give deflection.

(2) Loosen the locking nut on R3 control on the 516B-3 supply and turn the control fully counterclockwise.

(3) Turn on the transient generator. When the transient generator has charged the capacitance bank to 35 VDC as measured with a meter across the capacitors, throw the operate switch on the transient generator to the discharge position and note upward deflection of spot on the oscilloscope. Return operate switch to charge position.

(4) Turn R3 control clockwise a few degrees at a time while applying 35-volt transients until the spot just deflects downward. At this point lock the control R3 as this is the point where the transient protector of the 516B-3 is cutting out and protecting the power supply from transients of 33 volts or more.

CAUTION: ALWAYS BE SURE TRANSIENT GENERATOR HAS CHARGED TO 35 VOLTS BEFORE DISCHARGING AND THAT THE CONTROL R3 IS LOCKED AT THE POINT WHERE THE SPOT FIRST DEFLECTED IN THE OPPOSITE DIRECTION DOWNWARD. THIS ENSURES THAT THE TRANSIENT PROTECTOR CIRCUIT IS NOT SET TOO HIGH OR TOO LOW.



Transient Generator, Schematic Diagram
Figure 705